BRITISH HUSBANDRY;

EXHIBITING

THE FARMING PRACTICE

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WITH A SUPPLEMENT,

COMPRISING

MODERN AGRICULTURAL IMPROVEMENTS,

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BRITISH HUSBANDRY.

INTRODUCTION

The importance of agriculture to all the substantial interests of mankind is so fully recognised, that it may be deemed unnecessary to expatiate on the attention to which it is entitled, or to insist on the superior advantages which those nations must ever enjoy by whom it is the most skilfully practised. Some writers, indeed, without regarding the intimate connexion that subsists between every branch of human industry, have assigned to agriculture a superiority over every other art; but while claiming for it, to the fullest extent, pre-eminence over every mechanical trade, in all those considerations which mostly influence the choice of a profession, it would be inconsistent with that liberal spirit which forms so distinguished a feature in the character of the times, not to admit, that it has no real title to precedence before the manufactures of the country: the object of both is to promote the general weal, and it is unjust to ascribe any peculiar degree of dignity to either. Custom, however, which often arbitrarily decides in opposition to reason, has decreed that individuals, even of elevated rank, may engage in the cultivation of the soil, without descending from their station—a distinction which has not alone tended to raise it in the public estimation, but has also procured for it the more solid advantage of inducing many persons to embark in it, whose education and intelligence have suggested the idea, and whose fortune has furnished the means of making experiments upon a scale which could only rarely have been attempted by the mere farmer; and which, although they have not been adopted to the extent that might be wished, have yet greatly contributed to the flourishing condition of the land, and the consequent prosperity of the country. Nationally, therefore, it is rather matter of congratulation, than of jealousy, that such a distinction has been made in favour of an art in the successful prosecution of which the welfare of the community is so deeply involved; and, individually, it is, indeed, fortunate for many, that, without any diminution of personal consequence, the independent may find an agreeable occupation, and the less opulent a source of additional income, in dedicating some portion of their leisure to the pursuits of agriculture.

Although other avocations may offer greater prizes in the lottery of life, yet, if we compare the advantages of rural industry with those of any other of the common occupations to which men devote themselves, we shall find that he who is engaged in agriculture has no reason to be dissatisfied with the lot which Fortune has assigned him. Its superiority, in point of salubrity, over every sedentary employment, is too apparent to require illustration, and it affords more of those common enjoyments which constitute much of the elements of happiness, than any other state of equal mediocrity. The farm-yard, the orchard, and the dairy, supply, almost without expense, abundant means for those gratifications usually termed 'the comforts of life,' besides many luxuries that are beyond the reach of people of humble fortune; and the very business of the country furnishes,

in the use of riding horses, an amusement of only rare indulgence to the inhabitant of a town. It is true that it has its toils as well as its cares, and those neither few nor slight; and, perhaps, the mere peasant's life is more laborious than any other. But his cottage contains more homely comfort than the hovels in the crowded lanes of a manufacturing town; the morals of his children are not exposed to the contaminating influence, nor their health to the heated atmosphere of a factory; and if he fares harder than the artisan, he possesses more substantial sources of domestic happiness. Few persons, indeed, are insensible to the difference of mere animal existence, as enjoyed by the farmer who passes his days in the healthful labours of the field, and that of the mechanic or the shopkeeper, who wear away their lives at the loom or the counter; but it is not in that alone that the advantage consists.

Of all the feelings which we cherish, none is dearer to us than consciousness of independence; and this, no man who earns his bread by the favour of the public, can be said to enjoy in an equal degree with the farmer. Traders, as well as those termed professional men, are rivals, jealous of each other's success, and, let that be what it may, they still owe a deference to the world that is often galling to their spirit. But the farmer fears no competition. He may dread the importation of foreign corn, or he may be jealous of the encouragement given to Irish cattle; but those are feelings which he shares in common with his class; individually, he has nothing to apprehend from the success of his neighbour; he solicits no preference; and he owes no thanks for the purchase of his wares. His business, though subject to more casualties than almost any other, is yet so divided among many risks, that he is rarely exposed to the hazard of total failure; the same weather which injures one crop, often improves another, and the very difficulty of a critical season opens a field for exertion by which he is frequently a gainer *. Possessing on his land all the means of life, he is under no corroding anxiety regarding his daily subsistence; he is removed from those collisions of interest and those struggles for precedence which rouse the worst passions of our kind; and his constant observation of the beneficent dispensations of nature for the care of all her creatures, can hardly fail to impress him with a deep sense of that religion of the heart which consists in the conviction of, and reliance upon, the care of an all-ruling and all-bountiful Providence.

Nothing tends more to enlarge the mind, and to extend the sphere of our rational pleasures, than the contemplation of the economy of nature; and to those whom fortune has placed above considerations of pecuniary advantage, but who set a due value on intellectual enjoyment, the study of agriculture offers an inexhaustible fund of amusement, as well as instruction. The same objects, seen under different aspects, present an infinite variety of feature, and the most slender stock of appropriate knowledge, if aided by habits of observation and research, may be eminently useful in ascertaining facts hitherto unknown or unrecorded, and in thus illustrating a science which, however sedulously it has been explored, still opens a wide field for inquiry; while, even if not fortunate in the attainment of any material benefit, the mere occupation of the mind in tracing the origin and progress of any novel improvement, will be found productive of the purest gratification. It has been well observed by Sir Humphry Davy, that the frequent failure of experiments, conducted after the most refined theoretic

* "In twenty-four years' experience upon a considerable scale, I always made the most money in difficult seasons."—*Pitt's Survey of Leicestershire*, p. 53.

views, is far from proving the inutility of such trials; one happy result, which can generally improve the method of cultivation, is worth the labour of a whole life, and an unsuccessful experiment, well observed, must establish some truth, or tend to remove some prejudice *.

The principles of gardening and of agriculture (confining the latter to tillage only, instead of the more extensive sense in which it is commonly understood) are nearly similar; both are directed to the cultivation of vegetable productions, and the only material distinction is, that the former embraces a larger range, extending indeed, through the aid of artificial heat, to the whole vegetable creation, and demanding more minute and scientific arrangement, with closer attention—while the latter is conducted on a broader scale, and is necessarily limited to those plants which flourish in the open air

Through these arts, many herbs that were for ages regarded as weeds, and others that were exotic, are now cultivated among the most valued, as well as the most common, of our esculent vegetables; while several of those now grown in the fields were, at no very distant period, either little known, or considered as garden delicacies, and exclusively confined to the tables of the rich. There is still extant an ancient manual of cookery, entitled, '*The Forme of Cury,*' supposed to have been compiled about the year 1390, by the master cooks of King Richard II., in which, although elaborate directions are given for the preparation of '*cabaches,*' no mention is made of any other vegetables, except peas and beans, onions, leeks, and rapes; which latter were probably a species of turnip. Hume, indeed, tells us, that, 'it was not until the end of the reign of Henry VIII. that any sallads, turnips, or other edible roots, were produced in England; the little of these vegetables that was used being imported from Holland and Flanders, so that Queen Catherine, when she wanted a sallad, was obliged to despatch a messenger thither on purpose †.' Still later, we learn from an entry, dated in 1595, in the household book of the Cliffords, kept at Skipton Castle, in Yorkshire, that eleven shillings (a large sum in those days) were paid '*for vi cabishes and some caret-roots, bought at Hull*'—a seaport at the distance of full eighty miles; from which we may presume that they were imported, and purchased for some very particular occasion. In the commencement of the seventeenth century, one of the commonest of our present esculents, the potato, was regarded as so great a rarity, that it was only served in small quantities, and at the price of two shillings the pound, at the Queen's table; it was for a long time treated as a fruit, baked in pies with spices and wine, or eaten with sugar; and nearly two hundred years elapsed, from its first introduction into this country, before it was cultivated as a field crop.

Since that time, through the progress of botanical science, and the efforts made for the improvement of horticulture, many productions of the south have been naturalized in this country, and the introduction of the hot-house has made us familiar with the rarest exotics. Still, various foreign vegetables remain strangers to our culture, though adapted to our climate, and even some, which are indigenous to our soil, have not yet been brought into use, or are only slowly obtaining attention. It is not, indeed, to foreign nations alone that we are to look for new species of plants. Those which we already possess become so improved by cultivation, that new varieties of the same race are constantly produced, until, at length, by continued melioration, the parent stock is

* Elements of Agricultural Chemistry.
† History of England, chap. xxiii.

either lost, or neglected, and a new generation is created. Thus it has been supposed that not one of the numerous kinds and varieties of fruit, now found in our gardens and orchards, are what they were in their aboriginal state, and several appear to be absolutely new formations, the offspring of accident, or skill, rather than the spontaneous productions of nature. We are even ignorant of the native country, and existence in a wild state, of some of the most important of our plants; but we know that improved flowers and fruits are the necessary production of improved culture, and that the offspring, in a greater or less degree, inherits the character of its parent; the austere crab of our woods has been converted into the golden pippin, and the numerous varieties of the plum can boast no other parent than our native sloe *. Thus also, notwithstanding the attention bestowed by the ancients on the products of their gardens, and the probability that they were acquainted with a great proportion of the vegetables still in use, yet botanists find it difficult to reconcile the generic qualities of many plants, as they are described by the Greek and Roman authors, with the properties of those of the same species with which we are acquainted; we may, therefore, confidently infer, that an ample and unexplored field for future discovery lies before us, in which nature does not seem to have placed any limits to the success of our labours, if properly applied †.

If the faculty of increasing the stores which nature has already provided for his support, raises man above the brute, that of adding new productions to those in existence raises him above his fellow, and few subjects of contemplation can be more gratifying, or more elevating, to a reflective mind, than this power, as it were, of creation, granted to his intelligence and industry. Nor is it necessary to its enjoyment that we should be either botanists or natural philosophers; or that we should devote more than occasional leisure to the pursuit. So boundless, indeed, is the scope which it affords for experiment, that it is in the power of any one, possessed of the smallest garden, and the least acquaintance with horticulture, so to improve the qualities of its products, as to add something to the common stock of botanical riches, while enjoying a very delightful recreation. While the farmer, who will take the pains to mark the progress of his crops, and to select from them the most productive ears of corn, and the finest roots and grasses, for seed, may, by perseverance in such a plan, not only acquire wealth for himself, but confer an inestimable benefit on his country.

But it is not to the patriotism of the farmer that we appeal. That is a motive called into operation only on great occasions; it governs none of the common actions of life, and has no influence over ordinary minds; neither is it necessary to our purpose. Self interest alone is a sufficient inducement to most men to exert themselves in their peculiar walk, and, if properly directed, it accomplishes the object of society as well as if they were swayed by higher principles of conduct. We, therefore, only mean to call attention to the fact, that, when pursued with skill and assiduity, husbandry offers one of the surest sources, not merely of independence, but of fortune; in proof of which assertion, numberless instances could be adduced of men now living in affluence, acquired solely by farming, as well as of others who have left large property to their heirs

* Introduction to the Transactions of the Horticultural Society, and *Journal of Science and the Arts*, N.S., vol. i, p. 265.

† Beckmann's History of Inventions, art. '*Kitchen Gardens;*' and Transactions of the Hort. Soc., Introd.

Among the latter, Bakewell stands foremost—not so much for the fortune which he realized, as for the important results of his experiments, as a breeder, both to the public, and to his numerous followers; inasmuch as the improvements which he effected in live-stock, or to which his example has led the way, have contributed largely to the increase of animal food, and opened a branch of farming as novel as it has proved lucrative. Efforts had, indeed, been made before his time, to improve the different breeds; but they were comparatively feeble and ill-judged, until his penetration discovered the defects of the former system. He observed, that the moderate-sized, compact, small-boned animals were generally in the best condition; he, therefore, endeavoured to improve these desirable points, and to remove what he deemed blemishes; until, by slow degrees, but with great judgment and perseverance, he produced those varieties, of both cattle and sheep, which have since been distinctively termed, from his place of residence, the '*Dishley breeds.*' Such was his success, that, in one season, he received twelve hundred guineas for the hire of three rams, and two thousand for the use of seven; and, during several successive years, he never obtained less than three thousand for his entire letting. The spirit of emulation thus excited, and since so widely spread, gave rise to a singular division of labour among the sheep-breeders, who, until then, had usually been contented with the rams bred in their own flocks; but, from that period, it became a speculation to breed rams for the purpose of hiring them out. Some of these have been let so high as five hundred pounds for the season; one, the property of Mr. Buckley, was hired, in 1811, at a thousand; and, as the system has been extended from the Leicester to all the other favourite stocks, many of the '*Tup-masters,*' as they are called, have profited largely by the innovation *. Equally extraordinary prices have been given for cattle of superior quality; and it will be remembered, that a Durham bull—*Comet*—belonging to Mr. Charles Colling, of Ketton, was actually sold, by public auction, for a thousand guineas †.

Of Bakewell's immediate disciples, the Messrs. Culley, of Northumberland, were the most distinguished. They were among the foremost promoters of all agricultural experiments; and their superior intelligence, unremitting industry, and judicious application of the capital they gradually acquired, enabled them—from small original means—to leave their respective families each in the enjoyment of landed property to the amount of nearly four thousand pounds per annum, besides having largely contributed to the welfare of the surrounding country ‡.

To these examples must be added, that of one, less known perhaps, but not less worthy of imitation. The late Mr. Dawson, of Frogden, in Roxburghshire, was the son of a farmer in moderate circumstances. He was born in 1734; and after having assisted his father during some years, and having also obtained an insight into the English mode of farming, in Yorkshire and Essex, he took the lands of Frogden, and there commenced the plan of growing alternate crops of grain and grasses, or roots, and particularly of turnips, which he cultivated according to Tull's method. He was also the first to introduce the Norfolk mode of ploughing, with two horses abreast, into that part of the country; and, by perseverance in the

* Gen. View of the Agric. of the County of Leicester, pp. 248, 260.

† At this sale, which took place at Ketton, near Darlington, in October 1810, forty-seven head of cattle of the same breed, many of them calves, fetched the gross sum of 7168*l.* 7*s.*: and at a subsequent sale at Brampton, in the same county, sixty-one head of similar stock, the property of Mr. Robert Colling, brought 7858*l.* 4*s.*

‡ Farmer's Magazine, vol. xiv. p. 274.

prosecution of these improvements, he lived, not only materially to advance the husbandry of the neighbouring district, but also to purchase a considerable estate, and to leave a numerous family in very great affluence. He is described by his biographer, as having been 'exceedingly regular in his habits, and most correct and systematic in all his agricultural operations. His plans were the result of an enlightened and sober calculation, and were persisted in, spite of every difficulty and discouragement, till they were reduced to practice. Every one who knows the obstacles that are thrown in the way of all innovations in agriculture, by the sneers and prejudice of obstinacy and ignorance, and not unfrequently by the evil offices of jealousy and malevolence, must be aware, that none but men of very strong minds, and of unceasing activity, are able to surmount them: but such a man was Mr. Dawson *.' Yet this, however praiseworthy, is only the character by which every man of business should be distinguished: it displays none of that high talent which is the gift of nature, and may deter, if not defy imitation; nor any of those great acquirements which are only to be attained by deep study and laborious research. Mr. Dawson's success was the simple result of the discernment with which he had adopted the improvements of others, combined with the application of good sense, observation, and persevering assiduity, to an object which requires no extraordinary ability; and it surely is in the power of every man of plain understanding, and equal determination in the same pursuit, to follow in his footsteps, if not to attain equal eminence. He must, however, divest himself of prejudice; nor reject improvements merely because they are innovations on the practice of his grandfather. Not that a farmer should try every new experiment that is proposed, far less adopt any novel plan without due consideration. But if, after having weighed its advantages and disadvantages, with its applicability to the soil and means at his command, the former should appear to predominate—then let him afford it a fair trial; and let him recollect, that if a short cut to fortune sometimes lead a man astray, yet no one ever arrived at distinction by slavishly following the beaten track.

It is, indeed, deeply to be lamented, that such distinguished examples have not been more generally followed. Notwithstanding the acknowledged stride which agriculture has made in this country within the last half century, yet no science has been slower in its progress towards perfection; and even admitting numberless existing instances of intelligence and spirited management among farmers of the higher class, it is still an undeniable fact, that the great mass are men of a very opposite description. Brought up without sufficient education to enable them to comprehend the first principles of their art, acquiring it mechanically, as a mere trade, and either too dull or too indolent to seek information from books, they reject every proposed improvement as the visionary schemes of mere theorists, and even neglect them after their value has been proved by experience. Thus they invariably pursue the same routine they have learned in their youth, and adhere, with the obstinacy of satisfied ignorance, to obsolete customs, as detrimental to their own interest as to that of their landlords and of the public; and thus it is, that the average produce of many parts of the kingdom is below that of other districts of not greater natural fertility, and that the husbandry of the South, though more favoured by climate, is generally inferior to that of the North.

It is too true, that this jealousy of written information has been in a

* Farmer's Magazine, vol. xvi. p. 168.

reat measure justified by many crude publications of inexperienced persons, and that the sneers of practical men at what they contemptuously all '*Book-farming*,' are not wholly groundless. Much injury has been one to the cause of agriculture by sanguine speculations, which have only ed to expense and disappointment; but all works on agriculture are not f that character; nor should it be forgotten, that theory is the parent f practical knowledge, and that the very systems which farmers themelves adopt, were originally founded upon those theories which they o much affect to despise. Neither can it be denied, that systems grounded ipon theory alone, unsupported by experiment, are properly viewed vith distrust; for the most plausible reasoning upon the operations of ature, without accompanying proof deduced from facts, may lead to a vrong conclusion, and it is often difficult to separate that which is really iseful from that which is merely visionary. The art of husbandry depends o much upon patient observation and the test of repeated trial, and is nfluenced by so many casualties beyond our control, that it would be rash o adopt any general rules as invariably applicable to the endless varieties f season, soil, and incidental circumstances. Prudence, therefore, dicates the necessity of caution; but ignorance is opposed to every change, rom the mere want of judgment to discriminate between that which is urely speculative, and that which rests upon a more solid foundation

The prejudices of farmers against all innovation upon their established abits are as old as agriculture itself. In the dark ages of superstition, a nan who by any improved method contrived to grow larger crops than his ellows, was supposed to use supernatural means; and if he escaped proecution as a wizard, was at least shrewdly suspected of dealings with a ower whom his more pious neighbours carefully avoided. On the introluction of hops into this country, the city of London petitioned against heir use, lest they should injure the beer; and with equal wisdom the Kentish farmers, whose land was overrun with coppice, and who are now o largely benefited by their cultivation, objected to their growth 'because hey occasioned a spoile of wood for poles *.' New implements have been pposed upon much the same principle as the objection made about a cenury ago in Scotland, and so humorously as well as truly related by Sir Walter Scott, to the use of the winnowing machine †; and at this hour, he farmers in a large midland county assign as a reason for making the inder wheels of their waggons preposterously larger than the fore, 'that t places the body on a level in going up-hill;' never reflecting, that it vill have to come down again, or to move upon even ground.

Among numberless instances of a similar nature, it is told, that the late Duke of Bedford,—who, in his well-known zeal for the promotion of every gricultural improvement, took great pains to introduce the Norfolk nanner of ploughing, with two horses abreast,—observing, while riding in he neighbourhood of Woburn, one of his tenants at work, on that sandy oil, in the old-fashioned mode, with four at length, his Grace dismounted, yoked two of the horses together, and held the plough himself, explaining it the same time the advantages of the new method; but his disappoint-

* Harrison's 'Description of Englande,' book i. chap. xviii.

† 'Your leddyship and the steward hae been pleased to propose, that my son Cuddie uld work in the barn wi' a new-fangled machine for dighting the corn frae the chaff, hus impiously thwarting the will of divine Providence, by raising wind for your eddyship's ain particular use by human airt, instead of soliciting it by prayer, or waiting atiently for whatever dispensation of wind Providence was pleased to send upon the sheeling-hill.'—*Tales of my Landlord, Old Mortality*, chap. vii. It was introduced in the year 1710, from Holland, by Fletcher of Saltoun, and its use was publicly denounced from the pulpit, as impious.

ment may be imagined, when the man, instead of being at all convinced by his reasoning, replied, 'that such a plan might answer with his Grace, but was *too expensive* for him!' To which it may be added, that, notwithstanding the obvious economy and handiness of this mode of ploughing all light soils, and that, on such land, it has been adopted on every gentleman's farm throughout the kingdom, yet, with this example before the farmers' eyes, it has not yet entirely superseded the ancient cumbersome and expensive team.

Even in the settled and customary management of a farm, unforeseen difficulties occur that baffle experience; and in some cases, the merely practical farmer, who relies solely upon that, will be at a loss for expedients which an acquaintance with the practice of others might enable him to supply. There is, in this respect, assuredly much to learn, and no great difficulty in the task. For the rising generation, a more enlarged system of education is obviously the surest means; but the farmer who has not had that advantage, may easily acquire a practical knowledge of the various modes of culture and of rearing stock pursued in other districts, by occasionally visiting them after seed time, and adopting Bakewell's advice —'*to see what others are doing.*' He will thus be enabled to compare, in the most effectual manner, their different fashions with his own; and it is in this manner, that the intelligent farmers of the North—of Northumberland and of Norfolk, have surpassed their brethren in active enterprise and improved husbandry.

There is an old and an often-repeated adage, that—

'He who by the plough would thrive,
Himself must either hold, or drive;'

and this, which has become a prevalent opinion, has deterred many a man who has sought relief from the cares of trade in the retirement of the country from availing himself of the profit, as well as the amusement, which he might have derived from farming. It is unquestionably true, that the man who, from early habit, is capable of holding the plough, must have great advantage in the practical knowledge of that most important operation, over him who has not himself stood between the stilts; and it is earnestly to be recommended, that every youth who is destined to a farming life should personally assist in all the labours of the field, as the surest means of enabling him to direct them hereafter with effect; but nothing can be more erroneous than the supposition that the continuance of the toil is necessary to success. Formerly, indeed, when husbandry was confined to one dull round of drudgery, and when farms were generally so small, that the profit depended as much upon the personal labour as the capacity of the tenant, it might be true: but since the introduction of the present improved modes of cultivation, the more systematic attention to live stock, and the enlarged size of farms; since, in fact, agriculture has become a science, rather than a mere mechanic art, the time of a man who occupies sufficient land to employ only a few labourers, would be ill bestowed on manual toil. The axiom is not, indeed, always applied in its literal sense; but then it is construed to mean, that no man can hope to become a good farmer, who has not been bred to the business. Undoubtedly personal experience is necessary: but it may be acquired at much less expense of time and money than is commonly imagined, by any man who will sedulously devote his powers of reflection to the principles, and his attention to the details of farming operations, with a firm resolution neither to relax in his exertions, nor to suffer himself to be daunted by disappointment in the commencement of his career. Such a

man will be sure to succeed; and, as encouragement to perseverance, he may bear in mind, that many of the most eminent agriculturists, and those who have introduced the most important improvements in rural economy, were not originally farmers.

Jethro Tull, the father of the drill husbandry, was bred to the law; but having a small estate in Berkshire, he afterwards devoted himself to its cultivation. He was unsuccessful as a farmer, and he indubitably carried his theory respecting the continued growth of corn, without the intervention of fallows or green crops, too far. But the merit of his system of tillage, and especially that of horse-hoeing, on those soils to which it is applicable, has nevertheless been generally admitted, although it was at first deemed visionary, and thirty years elapsed before it attracted practical attention. The original invention of the thrashing machine is also due to a lawyer— Mr. Menzies, a Scotch advocate: we owe the introduction of mangel würzel to Dr. Lettsom; and the recent notice of fiorin to Dr. Richardson.

Both the late Arthur Young, and Marshall, whose writings have contributed so much to the diffusion of agricultural knowledge, were brought up to commerce; and it was not until the latter had attained to a mature period of life, that he turned his attention to the plough. He then, with little other previous preparation than what he had acquired from reading, entered upon a farm within ten miles of London, of three hundred acres of mixed soil, and which had been greatly mismanaged. This, for one so unpractised, was an arduous undertaking; yet within three months he discharged his bailiff, and became his own manager. The consequence, as might be expected, was, that he at first committed some blunders; but at the end of three years, he published his '*Minutes of Agriculture*,' containing the memoranda of his operations from 1774 to 1777, which, although not free from error, yet show, that he had even then attained to a greater proficiency than most of his contemporaries: but, to use his own language, '*attendance and attention will make any man a farmer* *.'

The notion that farming is unprofitable to any other than 'regular-bred farmers,' has been strengthened by numerous examples of persons who embarked in it during the late war, without any previous experience, or any other incentive than an expectation, encouraged by the high prices of the day and the exaggerated representations of some agricultural writers, that it would prove an advantageous speculation. Impressed with that idea, they gave exorbitant rents for land; their stock was purchased at an equally extravagant rate; and when the markets declined, they incurred enormous loss. The publication on the agricultural state of the kingdom in 1816, drawn up from the replies to a circular letter on the subject by the Board of Agriculture, teems with accounts of farms thrown up in every county; and, in many cases, the stock and crops were sold at less than half their original cost.

To these instances are to be added those, constantly recurring, of men in easy circumstances, who, without any knowledge of either the theory or practice of husbandry, engage in it merely for amusement, and not condescending to stoop to the details, are exposed to numberless impositions of their tradesmen and servants. They pay higher wages, and obtain lower prices, than their neighbours; they grow large crops, but at an expense that the sale will not repay; and, retiring at length in disgust, they declare farming to be 'a losing concern;' but without acknowledging that it only became so through their own improvidence.

* Digest of the Minutes, 4to., p. 63.

That such failures, however, do not always occur, we have the evidence of a very competent judge, who, alluding to persons who, having been in other lines of business, yet having a strong inclination for rural occupation, had betaken themselves to farming as a profession, says— 'this class forms the most intelligent and accurate of husbandmen. Like converts in religion, they have more zeal, give more application, in short, have fewer prejudices to surmount, and more enthusiasm for their new profession, than those who have been brought up in it from their infancy. They are, however, at the first outset, more liable to error or mistake, from the want of practice; but their indefatigable attention makes more than amends for their ignorance of the minutiæ of the art; and as they have been at some pains to acquire a knowledge in the theory of agriculture, and hence established their ideas on rational principles, they most commonly in the end make a distinguished appearance, as their labours, if judiciously performed, though often in a new and experimental channel, seldom fail of being crowned with success *.' He adds, that one of the best farmers in the county of Middlesex was a retired tailor.

That farming, when properly attended to, is not unproductive even to gentlemen who cannot themselves superintend all its details, we may appeal to the more recent testimony of Mr. Gawler; who, under all the disadvantages of an indifferent soil, and a quantity of land inadequate to the charge of a bailiff, and pursuing an unostentatious system of husbandry, unmarked by any peculiarity of management or extraordinary expenditure, yet admits, in the very instructive account of his farm lately published, that he has succeeded in deriving a net average profit from its produce, much more considerable than any rent he could have obtained from a tenant; and has had, besides, the advantage of keeping the property in a state of neatness, the fences in a state of repair, and the land in progressive improvement, uninjured by exhaustion †.

It is, indeed, evident, that all those staple manufactures, which contribute to the supply of our absolute necessities, must always yield a fair return, upon an average of years, upon the capital employed, or they would be abandoned. Even the so much dreaded importation of foreign corn, would have no other permanent effect than to cause so much land to be thrown out of cultivation as, by diminishing the supply, would maintain prices at a remunerating rate; and farming would still continue upon the same footing as brewing and malting, or tanning and weaving, or any other of the great manufactures of the country. A temporary reduction of prices would no doubt ensue, farming-stock would suffer in proportion, and, if the alteration were sudden, much individual embarrassment would be created; but corn cannot long continue to be sold for less than it costs to produce it, and Great Britain must ever rely upon her own soil for the chief supply of her wants, for, were her ports thrown open to the unrestricted admission of grain, it is not in the power of the united surplus capital and industry of the world to meet them. Rents may fall; but farming profits cannot; and, so long as there are consumers for the products of the land, so long will husbandry continue to reimburse those who embark in it with adequate means and knowledge.

Agriculture possesses, too, the advantage of presenting a wider range than most trades, for the exertion of skill and industry; and if it does not so often lead to wealth, it affords a surer competence, and is less subject to

* Middleton's View of the Agriculture of Middlesex, 2d Edit., p. 59.

† Library of Useful Knowledge, Farmers' Series, No. 7; Report of a Farm in North Hants, by Henry Gawler, Esq., p. 5.

total failure. It is very important that these encouragements to the application of capital to the soil should be generally understood; for the national prosperity is involved in its success as the main-spring of all industry, and in that every man in the kingdom, from the wealthiest peer to the poorest labourer, is interested. The term 'National Prosperity' is very commonly applied merely to the resources of government, and although these are derived from the common stock, it is yet difficult to convince a poor man, that he, who apparently shares none of the national wealth, can be at all concerned in its amount. But although money may be accumulated in a few hands, and there remain inactive, and useless to the community, yet the fruits of the earth cannot be so hoarded; when once produced they must be distributed among the people, for no one can consume more than a certain quantity; and in proportion to the amount, each individual gets more or less, as his share. Each may not be able to procure as much as he wants; but he certainly would obtain still less, if less were produced in proportion to the population. Every increase of product, however slight, and although only apparently beneficial to those who directly profit by it, is therefore eventually advantageous to the whole nation; and not only is more food thus obtained, but work, by which it may be purchased, is also provided in the growth and manufacture of raw material. The whole wealth of the world has been acquired by labour. In the early stages of society, it was solely employed to procure food and shelter; but when the course of civilization taught a more economical and effectual application of its power, it was found that a few individuals could supply the wants of many. Hence the superfluous number became manufacturers; and, as the arts advanced, and machinery was invented, those conveniences were gradually introduced which have now become indispensable to our comforts. The list of these has grown with the progress of knowledge and refinement, and many things, which in the infancy of society were deemed luxuries, are now included among our most common necessaries. Thus, in every country, the condition of the people is seen to depend upon the degree of skilful labour which it can command: but the plough is the prime mover of all, for until a sufficiency of food be produced for the common consumption, no one can be spared from the cultivation of the land; and it is obvious, that in proportion to the perfection of that cultivation will be the amount of subsistence obtained, and the number of spare hands left for other purposes. The means of support in other branches of industry being thus secured, the demand for the produce of the land increases along with the produce of that labour; more hands are then required for its cultivation, and these again require more manufactures. Thus industry and wealth keep pace with agriculture, and, each stimulating the other, contribute to the national prosperity. That such is the effect of agriculture on the welfare of the community, is proved by the history of its progressive improvement, and of the consequent change in the mode of living, in this country; of which a brief sketch may not, perhaps, be either irrelevant to our subject, or wholly unacceptable to the general reader.

Some faint attempts at cultivation appear to have been made in Britain at a period beyond the reach of history. They were, however, in the rudest style of simplicity, and were attributed to a colony of Gauls, that was supposed to have settled on the southern coast, about a century prior to the invasion of Julius Cæsar. We have no particulars of the state of agriculture in England during the dominion of the Romans; but that great improvements were made during their possession of the country, might be

inferred from their invariable efforts to introduce their own customs into all their conquests, as well as collected from many passages in ancient authors, were it not also evidenced by the still existing remains of roads, and other vestiges of civilization in their time, and proved by the recorded fact, that, besides the support of a large army quartered in the territory which they held, they annually drew from it large supplies of corn. The common arts of life for the subsistence of man are not easily lost, and it cannot be supposed that the endeavours of that great people to promote them during a continued occupation of more than three centuries, from the reign of the Emperor Claudius to the final recall of their troops, could have been wholly obliterated by the subsequent inroads of the Picts, or the more formidable irruptions of the Saxons and the Danes. It may indeed be presumed, from the coarser habits of these predatory hordes, that they set less value than their predecessors upon the advantages of cultivation, or took less pains to obtain them; but, although they changed the laws, the religion, and even the language of the people, yet the remains of Roman agriculture may be traced in some of their regulations regarding inclosures and tenancy *, as well as in the precision with which the boundaries of land are marked in the records of Doomsday book, which survived the shock of the Norman conquest, and exist even at the present day.

Little else is known of the state of husbandry during the Saxon era, except that it was reduced to the lowest ebb of imperfection. So little was the division of labour understood, that the ploughmen were expected to make their own ploughs, the harness for which was composed of withes of willow, and iron seems to have been but little used in the construction of field implements. Although among the curious collection of ancient drawings for which we are indebted to the research of Mr. Strutt, we find a plough drawn by four oxen, yet the common team consisted of eight, and this cumbrous power was wasted upon the stirring of about half an acre in the day. Among all these antique delineations, gleaned from old missals, and other illuminated manuscripts, it is remarkable, that no representation has been found, in this country, of the harrow; but amongst the figures upon the border of that extraordinary relic, the *Toile de St. Jean*,—more generally known as the Bayeux Tapestry,—which is coeval with the Norman conquest, there is one of a man ploughing, and another following with a harrow; which proves that it was then used upon the continent, and, if not previously known here, must have been introduced at that period. Thrashing was performed with the flail; although that is not the most ancient, nor, even now, the common mode in many foreign countries; and, besides the plough, some of the implements in present use appear to have been then employed †.

Land was so little valued, that, in the tenth century, four sheep were deemed equivalent to one acre, and a horse to five; but neither the value of the cattle, nor the nature of the soil, is mentioned, from which we may conclude, that there was little distinction of breed among the former, and that the latter was the common average of pasture. A right of temporary occupation might be acquired upon the sole condition of leaving the ground manured at the end of a twelvemonth; and yet so little of it was ploughed, or so deficient was the tillage, that it barely afforded bread of the coarsest kind to the scanty population. The demesnes adjoining the dwellings of the great proprietors were cultivated on their own account, by labourers who were bound to the soil, and might be transferred along with

* See Sharon Turner's Hist. of the Ang. Sax., vol. ii. Append. iv.

† See Strutt's View of Manners, &c., vol. ii. p. 13, and plates 9, 10, and 12, vol. i.

the estate. Those which were leased, were let for rents payable in kind, and extending to every article in common consumption; for money was of comparatively little use in a country where foreign commerce could scarcely be said to exist, and in which the internal communication was so imperfect, as hardly to allow of more than a petty barter, with some neighbouring town, of articles of mere subsistence for those of the most ordinary uses of labour and wearing apparel. Even fines to the crown were often commuted by payments in produce; and it appears, from the laws of Hoël Dha, that ewes were the common standard of value in Wales *.

The lawless habits of the age compelled the people to live together in villages for their mutual security. Much of the land was therefore cultivated jointly, and to each hamlet there was annexed a certain quantity of open pasture, which was enjoyed by the inhabitants in proportion to the extent of their arable ground: a custom to which the origin of existing common rights may be distinctly traced. The occupation of these farms appears to have been regulated by statute, and one of the earliest enactments extant on the subject—previous to the time of Edward the Confessor—requires, that 'a husbandman possessed of twenty hides of land, should leave twelve sown with corn when he gave up the tenancy†;' which supposes larger farms and more independence than a state of vassalage would warrant, as well as greater capital than a mere peasant could command. But the stock was usually furnished by the owner of the land, and charges are even found, in some old manorial records, for the hire of the lord's plough ‡. The farmers were denominated *Ceorls*, or Churls, and with the *Thanes*, or proprietors, were the only freemen; the peasants in the immediate service of the landlord were in actual slavery, and, though not in the opprobrious sense now attached to the word, were termed *Villeins*.

The agricultural picture of the kingdom, as it is represented in Doomsday Book, at the Norman conquest, describes the country as generally in uninclosed pasturage, or covered with vast tracts of forest and unproductive coppice. Arable land is, indeed, constantly specified in the survey, and seemingly bears a large proportion to the size of the manors; but this arises from the omission of the waste and common pasture, which usually formed the largest part, and we may judge how small must have been the quantity actually under the plough, from the amount of the population,

* Archæologia, vol. iv. p. 61.

† *Lansdowne MSS., Brit. Mus., No.* 558, *p.* 108. There have been various conjectures respecting the quantity of this ancient measure. It is commonly suspected to have contained about 120, or, according to some authors, 100 acres; (*Harrison, Pict. of Engl.*, b. xi. c. xix.) but we find it used, in old books on husbandry, synonymously with the *Ox-gang*, *Plough-land*, and *Carrucate*; each of which seems to have consisted of as much as one team could plough in a season. This, however, must have varied according to the quality of the land; and so much uncertainty prevails on the subject, that it is estimated, in various instances in Doomsday Book, from forty acres to six. Mr. Sharon Turner estimates it at 120 acres; though he admits that the Carrucate 'implies so much land as a single plough could work during a year;' (*Hist. of the Ang. Sax.*, b. ii. App. iv. c. vii.)—But another intelligent antiquarian, who has devoted much attention to the subject—the Rev. Mr. Whittaker—has produced a record of the endowment of seven different chapels with glebe-lands, which were severally designated by the number of Ox-gangs in each; and these, which still continue distinct from other church property, have been ascertained to vary from fifteen to twenty-two acres each. Mr. W. assumes sixteen to have been the average; (*Hist. of Whalley*, b. ii. c. iii. and b. iii. c. i.) Sir Samuel Toller, in his Treatise on Tithes, considers an ox-gang as equal to sixteen acres, and it is also nearly evident, that the instance alluded to in the text cannot have reference to the larger measurement.

‡ Archæologia, vol. xviii. art. xxx.

which has been calculated at only 1,504,925 souls *. The woods were preserved both for fuel, and for the support of hogs, which fed upon the oak and beech-mast, and formed a large portion of the sustenance of all classes; and numerous rabbit-warrens were maintained, chiefly to supply furs for the dress of the higher orders. Great part of the northern districts, which were then less peopled than the rest of England, was tenanted by numerous herds of deer,—among which it has been conjectured, that the moose existed,—together with the wolf, the wild-boar, and the wild-bull. Some descendants of the latter are still preserved in their wild state at Chillingham Castle, and a few other ancient mansions in the North: they are invariably of a cream colour; their muzzle, and tips of the horns black, and the whole inside of the ear, with a portion of the upper part, of a pale red; but it is somewhat singular, that those at Gisburne Park, in Yorkshire, are hornless †. They are noticed by Leland, in the reign of Henry VIII.; and even so late as that of Queen Elizabeth, swine ran wild over the fells of Lancashire and Cumberland, and in the Weald of Kent ‡. It is commonly supposed that the race of wolves was destroyed in the reign of Edgar, about the middle of the tenth century; but their existence in that of Stephen has been proved by the discovery of the record of a grant by Conan, Duke of Britany, to the monks of the abbey of Fors, in Wensley Dale, 'of pasturage and grass in the adjoining forest,' but forbidding them to use any mastiffs to drive away the wolves §

With such incentives to the chase, we cannot wonder that it was pursued with ardour, both as a pastime well-suited to the robust habits of the age, as well as an agreeable means of procuring many delicacies for the table, which, in winter especially, was otherwise but ill-supplied. Rigorous laws were accordingly enacted for the preservation of the game: poaching was more severely punished than by modern landlords; and it was even more penal to kill a stag than a man. Those edicts have been attributed to the Norman kings; but a code of laws reserving the right of free-warren to the monarch and his nobles is supposed to have been promulgated in the reign of Canute ‖. By these, the freeman forfeited his liberty, and the slave his life, for slaying a staggon, or royal beast; though the murder of the former might be commuted on the payment of two hundred shillings, and of the latter for half that sum ¶. But after the Norman conquest, freemen trespassing against the king's venison were punished by mutilation, or the loss of sight—penalties which appear to have been inflicted with no sparing hand under some sovereigns, and existed, with some modification perhaps in their execution, until the accession of Edward I., when all the sanguinary part of the code was repealed, and pecuniary fines were substituted.

Although it cannot be denied that the severity of these laws was inconsistent with a liberal spirit of legislation, it is yet probable that the security of the game was not their only object, and that their aim was partly the prevention of greater crime than its destruction. The great abundance of animals of the chase held out a most alluring encouragement

* Sharon Turner, Hist. of the Ang. Sax., vol. iii. p. 252.

† Whittaker's Hist of Craven, p. 37.

‡ Hasted's Hist. of Kent, vol. ii. p. 237. Whittaker's Hist. of Manchester, 2d Edit. vol. ii. p. 115.

§ Burton's Monast. Ebor. under Fors Abbey, fol. pp. 366, 370, 371.

‖ Doubts have been entertained respecting the genuineness of these laws—(*Constitutiones de Forestâ*)—which, however, seem successfully refuted in a note to Whittaker's Hist. of Whalley, fol. b. iii. c. iv. p. 193.

¶ Wilkins's Leges Ang. Sax. Eccles. et Civ., p. 221.

to idle vagabonds, who were thereby enabled to live in plenty and in freedom · the vast extent of the covert afforded them protection; and, from poachers, they became robbers. There was not, indeed, the same incentive to petty thieving that exists at present, nor were their depredations committed with the lurking caution of the midnight poacher, who steals upon his prey and snares it; they pursued it openly, and there was that manly daring in the wild adventure of their woodland lives, which excites an interest in its success, and creates an excuse for its lawless violence; but, however romantic the feats of Robin Hood and his associates, and, however hallowed in our recollection by the charms of poetry, they were not the less the deeds of outlaws and of ruffians.

The privilege of free-warren, although widely exercised, was not so injurious to the farmers as might be supposed, for the greater part of the land in their occupation was in common-field, and the alternate system of corn and green crops not being then understood, the only crop upon the ground in winter was wheat; there were no fences to break, and few trespasses could have been seriously complained of. Neither was the game generally pursued on horseback. The stag was more frequently the victim of the bow and arrow, than of the regular chase: a document in the department of the Comptroller of the Wardrobe to Edward I., stating the expense of his majesty's fox-hounds for the year 1300, contains no charge for horses except for one *to carry the nets;* from which it has been inferred, that even the attendants of the royal hunts followed the sport on foot.* It may interest some sportsmen of the present day to know, that the entire charge of the pack amounted to 23*l.* 7*s.* 1*d.*

The expulsion of the inhabitants from part of Hampshire, by William the Conqueror, to form the hunting-ground of the New Forest, has been a theme of reproach with all historians; but tyrannical as was that act, and a similar devastation of the country between the Tyne and the Humber, under pretence of guarding against an invasion of the Danes, yet neither these, nor the subsequent encroachments of succeeding monarchs, in extending the bounds of the forests, could have had any very sensible effect on the agriculture of a country, the far greater part of which was still in a state of absolute waste, and as little valued as the wilds of America at the present hour. There is, indeed, reason to suppose that it suffered temporary injury through the rapacity of the nobles in dispossessing the ancient proprietors of the soil; and we are told by an ancient writer, that, in the reign of Stephen, 'to till the ground was to plough the sea; the earth bore no corn, for the land was all laid waste †'. But the accounts transmitted to us by Saxon chroniclers, of the conduct of their invaders, are to be regarded with suspicion: the Normans were certainly more advanced in the knowledge of agriculture than the inhabitants, and, from their superior civilization, it may be presumed that they were at least as solicitous to enjoy its benefits; nor can it be doubted, that their example finally tended to its improvement.

The acute historian of the Middle Ages has justly observed, that 'even in the least civilized periods, there were not wanting partial encouragements to cultivation, and the ameliorating principle of human industry struggled against destructive revolutions and barbarous disorder. The devastation of war, from the fifth to the eleventh century, rendered land the least costly of all gifts, though it must ever be the most valuable and per-

* Beckmann's Hist. of Inventions, art. '*Hunting.*' Small Edit. 2 vols.
† Chron. Sax. ann. 1154.—Ingram's edit. 4to. p. 367.

manent. Many of the grants to monasteries, which strike us as enormous, were districts absolutely wasted, which would probably have been reclaimed by no other means*.' Although the monks are vulgarly considered as an idle and worthless class, yet he shows that the agricultural riches of a great part of Europe are due to them, and the earliest improvements in English husbandry are ascribed to their intelligence and industry. They were, in that early age, the only persons acquainted with the learned languages, in which alone were found the records of the agriculture of the Romans, which those who are conversant with georgical literature know to have been carried to a considerable degree of perfection; their correspondence with Italy, as well as occasional missions to that country, and other parts of Europe, made them acquainted with foreign modes of culture; and their education, their habits, and their wealth, enabled them to apply the knowledge thus acquired with more skill and effect than could have been exerted by a warlike nobility more devoted to arms than to the arts of domestic life. They were indulgent landlords; their large revenues secured their tenants from the exactions which they suffered under less opulent proprietors, nor were they so much exposed to the hazardous services required of the retainers of the military landholders. They paid more attention to the moral conduct and the welfare of their dependants, and the courts under their jurisdiction were less arbitrary than those of the great feudal lords. The protection thus afforded, attracted many free settlers to the neighbourhood of the religious houses; the lands belonging to them were more thickly inhabited, and better cultivated than other estates†; and the remains of agricultural buildings‡, the vestiges of orchards, and other improvements then but little understood, together with the records of abbeys, both in this country and on the continent, incontestably prove, that even at the remote era of the Norman conquest, much care and attention were bestowed upon rural economy by the monastic orders.

Although agriculture gradually advanced from this period, yet the paucity of the population, and the insecurity of the country, still confined cultivation to the land adjacent to the mansions of the nobility, in which the Norman Baron, as well as the Saxon Thane, lived in solitary independence, surrounded by his vassals, and owning no superior but his sovereign. Such a state of simplicity, and freedom from those 'trammels of the law,' by which the interests of more civilized society are guarded, may have charms for the admirer of uncultivated nature, but the enjoyments which it afforded belonged only to the owner of the soil. The condition of the lower classes was wretched. Their huts contained neither beds, nor moveables of any kind, except the few common utensils requisite to the preparation of their food: the peasant reposed on straw, spread upon the floor, with a log of wood for his pillow, or stretched himself in the stable with his cattle; and even the upper sort of husbandmen fared very little better. Of these, at a much later period, we are told by an accurate observer of the manners of his day, that, 'if within seven yeares after their marriage they had purchased a flocke bed, and thereto a sacke of chaffe to rest their heads upon, they thought themselves as well lodged as the

* Hallam, View of the State of Europe during the Middle Ages, 2d edit. 4to. p. 509.

† Ibid., passim, and Sharon Turner's Hist. of the Anglo-Saxons, vol. ii. p. 167.

‡ One of these—a barn—upon the manor farm of Cholsey, in Berkshire, is one hundred and one yards long, eighteen yards wide, and is supported by thirty-six pillars of stone, each a yard square; and another, at Great Coxwell, near Farringdon, built by the Abbots of Beaulieu, though not so large, is still remarkable for the strength and beauty of its masonry.

lorde of the towne, that peradventure laie seldome in a bed of downe or whole feathers *' Their houses were constructed of wattles plastered over with clay, and without either glass windows, or chimnies: the fire was either made upon the earthen floor, in the centre of the room, or against a 'rere-dosse,' or a hob of clay placed before the wall; and the oxen were stalled under the same roof †. Their furniture was correspondently mean; and we learn from that strange medley of satire, morality, and manners, '*The Vision of Piers Ploughman*,' which is supposed to have been written by a Shropshire priest, about the middle of the fourteenth century, that the bread then in common use was composed of peas and beans ‡.

The accommodations of the higher orders were not much superior. Even the baronial hall was only lighted through wooden lattices, or, where unusual grandeur and delicacy were affected, through windows closed with horn or parchment; the naked walls of the apartments were only occasionally hung with loose tapestry, to conceal the rudeness of the masonry; the floors were strewed with rushes, instead of carpets; the beds were partly, if not wholly, composed of straw §; and the lord of an extensive domain indulged in fewer luxuries than a modern farmer. More than a century later, the most distinguished families ate off wooden trenchers, or pewter plates; forks were unknown; and even in 1572, the princely residence of Skipton Castle held only eight mattresses and bolsters in the lodging of thirty-five household servants ‖. Even the homely fare of which they were possessed was dealt out to their domestics with a parsimonious regard to economy, and nothing is farther from truth than the idea, so commonly entertained, of the abundance and profusion of ancient times. But, in fact, they were not rich, even according to the estimation of money at that period. An income of ten or twenty pounds a year was reckoned a competent estate for a gentleman; and a knight passed for extremely wealthy with one hundred and fifty pounds per annum: yet this, according to the calculation of Mr. Hallam, (who supposes twenty-four to be a sufficient multiple when we would raise a sum mentioned by a writer under Edward I.,—ann. 1300,—to the same value in our money,) was only equal in command over commodities to 3600*l.* ¶ The cause of this comparative poverty can only be ascribed to the imperfect state of cultivation, for many of the estates in the hands of individuals were larger than at present, and the price of corn was comparatively higher: but the same quantity was not gained from a similar space of ground. The stimulus of trade was also still wanting; and without that there is no incentive to labour for a surplus beyond the wants of mere sustenance. Living in the midst of his retainers, the feudal chieftain was supplied either from the produce of the land surrounding his dwelling, or by the contributions of his more remote tenants; his expenses consisted principally in the exercise of a rude hospitality; and the few foreign luxuries which the habits of life then rendered necessary to enjoyment, were obtained in exchange

* Harrison's Description of England, prefixed to Hollinshed's Chron., fol. p. 8.

† Beckmann's Hist. of Inventions, art. '*Chimneys*.'—Whittaker's Hist. of Craven, p. 334.—and Hallam's Middle Ages, 4to. vol. ii. p. 505.

‡ 'A few croddes and creyme, and a cake of otes,
And bred for my barnes (*children*) of beans and of peses.'
[*Visio Will.' de Piers Ploughman, pass. non.* 144.

§ The regulations for the household of King Henry VIII. contain an order '*to examine every night the straw in the king's bed.*'

‖ See the Northumberland Household Book, p. 75.; Beckmann's Hist. of Inventions, art. '*Forks*'; and Whittaker's Hist. of Craven, p. 337.

¶ View of the Middle Ages, 4to., vol. ii. p. 520.

for the wool and hides of his flocks and herds, in which, from the great extent of its pasturage, the kingdom abounded, and which, for the opposite reason, were scarce in Flanders, to which country, and France, commercial intercourse was nearly confined. But the industry of the Flemings having extended to agriculture as well as to manufactures, afforded no market for grain: France was fed by its own fertile territory; and Italy, through which were procured a few articles of Eastern luxury, for which a taste had been acquired during the Crusades, was equally independent of the products of the English soil.

The annals of agriculture at that remote epoch are scanty and uninstructive: there is no work extant on the subject, and so little has it been noticed by historians, that it is involved in much obscurity. But from an ancient Latin tract, supposed to have been written about the latter end of the thirteenth century, and which, although chiefly a treatise on law, yet contains many passages relating to rural economy, we learn, that husbandry was conducted with more regard to precision than might be thought consistent with the rude habits of the times. It points out the several duties of the steward, the bailiff, and the labourers; from which it appears, that even in that age, when education was so rare, the farm accounts, on large properties, were kept with scrupulous accuracy; and it gives many directions respecting the tillage of land, and the management of cattle, that are not inapplicable to the practice of the present day. Yet the learned author estimates the possible returns from the soil so low, as to inform us—that unless an acre of wheat yielded *three times the seed sown*, the farmer would be a loser, if corn were not unusually dear. His calculation is as follows:—

	s.	*d.*
Three ploughings . .	1	6
Harrowing . .	0	1
Two bushels of seed . .	1	0
Weeding . .	0	0½
Reaping . .	0	5
Carrying .	0	1
	3	1½*

which is about the value of six bushels of wheat at the time he wrote, and exclusive of rent, of which nothing is said. But Sir John Cullum and Sir F. M. Eden, who have devoted much attention to the subject, assume the average crop to have been about twelve bushels †; and the former remarks, that, '*Supposing 4s. 6d. to be about the mean price of a quarter of wheat, and 4d.* a year's rent of an acre of land, the disproportion between the produce of the land and its rent is almost incredible; for if an acre produced in general only a quarter and a half, it would, if the ground was cropped only two years together, give the husbandman thirteen times the rent of his land, one year with another; a profit which the best farmers in the present state of improved agriculture can rarely reach.' This, however, supposes the ground to have borne two crops of corn in every three years, which, under the system then pursued, was barely possible on the best soils; for, independently of the disadvantage of indifferent tillage, manure was so scarce, in consequence of the cattle being almost entirely pastured on the wastes, that it was not uncustomary for the lord of the manor to reserve to himself the privilege of having his tenant's sheep folded upon his own farm; and lime, since so extensively applied to the meli-

* Fleta, Comment. Juris Anglic., lib. xi., cap. 82. sect 3.

† Cullum, Hist. of Hawstead, ch. iv.—Eden, State of the Poor, 4to. vol. i., p. 48.

oration of some soils, was so dear, that an account in 1437 shows the price, near the kiln, to have been one-third more than that of oats *. There can be little doubt, therefore, that the land, after having been exhausted by repeated cropping, was necessarily allowed to recover its fertility, during a series of years, in a state of fallow, or unproductive natural grass, for an artificial mode of laying it down to meadow seems to have been unknown; and we have, besides, records of the frequent and almost entire failure of the crops, of murrain among the cattle, and consequent extraordinary fluctuations of price, accompanied with frightful details of famine, unknown to modern times in any even tolerably cultivated country. Wheat often varied from four to sixteen shillings, and Stowe mentions its being sold, in 1315, at forty shillings the quarter. He says, in his account of that dearth, that dogs and horses were used as delicious food; and he adds, that—'Theeves that were in prisons did plucke in peeces those that were newly brought amongst them, and greedilie devoured them half alive: some (it was sayd) compelled through hunger, in hidden places, did eate the fleshe of their owne children; and some stole others, which they devoured †.'

This surmise respecting the state of arable land is in a great measure corroborated by the comparatively high value of meadow, which usually let at six and even eight times its rent ‡; a disproportion which can only be accounted for, by the greater certainty of its produce, as it exceeded the difference between the expenses of tillage and grass, and may be justly regarded as one of the strongest proofs of imperfect culture. There is also reason to believe, that twelve bushels of wheat per acre is too high an estimate of the average product; for in the history of the parish of Hawstead, in Suffolk, the returns in 1387, of the manor farm, which may be presumed to have been at least as well cultivated as others of similar medium soil, are stated thus:—

66	acres of	Wheat	produced	69 qrs.	2bls.	of Grain.
26	,,	Barley	,,	52 ,,	2 ,,	,,
62	,,	Oats	,,	40 ,,	4 ,,	,,
25	,,	Peas	,,	25 ,,	3 ,,	,,
25	,,	Haras	,,	28 ,,	0 ,,	,, §

and in that of the manor of Dorking, in Surrey, about the same period—

30½	acres of	Barley	produced	41 qrs.	4bls.	of Grain.
28	,,	Oats	,,	38 ,,	4 ,,	,,
5½	,,	Tares	,,	1 ,,	6 ,,	,, ‖

Hawstead farm contained 572 acres; of which 321 were in tillage, 30 meadow, and the remainder wood and pasture. The stock consisted of 26 cows and a bull, with 6 heifers and 6 calves; 10 working oxen; 4 cart-horses, and 6 colts; and 92 muttons, with 10 score of hoggerills, or two-year old sheep. The cows were fed, during the winter, with rack-

* Whittaker's History of Craven, p. 324.

† Stowe's Chronicle, p. 218, fol. edit. 1631.

‡ Many instances might be adduced to that effect; but perhaps the earliest upon record, by a regularly indented and witnessed deed, is that cited in Cullum's history of Hawstead, (p. 206,) of two acres let, anno 1270, for six years certain, at 3*s*. per acre. The whole parish is valued in Doomsday Book, at 1*s*. 2*d*. per acre; and the arable land, at the period of the lease, was not worth more than 4*d*.

§ Sir J. Cullum conjectures that the *haras* was used as horse-food; but is unable to describe it: the price of thrashing was the same as for oats—2*d*. per quarter; while for wheat it was 4*d*. (*History of Hawstead*, chap. iv.) Perhaps it was similar to the *skegs* now grown in some parts of the north, or to the *pilez* of Cornwall.

‖ Archæologia, vol. xviii., art. 30.

meat in the yard; and, as the whole of the hay was devoted to their support, the rest of the cattle must have been maintained throughout the year, either along with the sheep upon the pasture, or with the straw and haulm. Such a system naturally produced an inferior stock; and, accordingly, the produce of a good cow, during the summer half year, which is the only time mentioned, was rated at 128 pounds of cheese, with *half a gallon* of butter weekly. The price of a cow with her calf varied from six to ten shillings, and the produce of the milk of an ordinary one was valued at twopence three farthings per week. Ewes were also milked, and twenty, if well kept, were thought equal to three cows *.

The number of working cattle at Hawstead is at variance with other accounts; and in one kept by the bailiff of the manor of Flaunchford, near Ryegate, from 1382 to 1386, twelve plough oxen are stated as the number used upon fifty-six acres of arable, of which sixteen were fallow †. But it is not improbable, that part of the work at the former was performed by the customary service of the tenants of the manor, for more than five hundred persons were employed to get in the harvest, which was thus completed in two days, while in other places its average duration was five weeks. It was then, as now, a season of festivity; and harvest-home appears to have been a scene of much rustic jollity, accompanied with some customs that have since fallen into disuse ‡.

About that era, the reign of Edward III., may be dated the dawn of general improvement in this country. The intercourse between nations, which had been opened by the Crusades, had tended to the increase of civilization. Europe began to emerge from the barbarism in which it had been sunk during the middle ages; and, from the spirit of inquiry which then spread throughout the kingdom, there can be little doubt, that agriculture would have made rapid advances, had it not been checked by the subsequent wars between the rival houses of York and Lancaster. But even that struggle, although at the moment unfavourable to husbandry, eventually contributed to its advancement. The nobility and gentry, who took part in the conflict, were obliged to commute much of the personal services due by their tenants for rents in money, in order to meet their expenses in the field. Many bondsmen were thus emancipated; and acquiring, together with their release from servitude, an interest in the soil which they had not previously possessed, they applied themselves with more earnestness to its cultivation. The estates of many landholders were either dismembered to pay off mortgages incurred during the long continuance of that civil strife, or falling, at their death, to collateral heirs, were divided among a much greater number of proprietors, who, severally drawing their subsistence from a smaller portion of land, were necessarily compelled to devote more attention to its improvement. The increase of population, and the charters granted to corporate bodies, swelled the number of inhabitants in the towns; and markets, which had not previously existed, were opened for the produce of the country. Although, as we have already seen, leases had been long customary, yet they were voidable by the sale or alienation of the land; and the tenant's property was even subject to the debts of his landlord; but both of these abuses were rectified by statutes passed in 1449 and 1469. Thus the dissensions by which England was agitated throughout the greater part of the fifteenth century,

* Archæologia, vol. xviii., art. 30.
† Ibid.
‡ See Cullum's Hawstead,—Bloomfield's Norfolk,—Dugdale's Warwickshire, and Tusser's Five Hundred Points of Good Husbandrie.

gradually contributed to the amelioration of her civil institutions, and gave rise to that middle order of society to which much of its prosperity in the succeeding ages is to be attributed. The progress of agriculture during that period is, however, rather to be inferred from circumstances than deduced from facts, for we are only imperfectly acquainted with the rural economy of our forefathers under the Plantagenets.

The first work, exclusively on agriculture, known to have been written in England, is a small tract, '*whyche Mayster Groshede, sometyme Bishoppe of Lyncolne, made and translated out of Frenshe into Englyshe.*' It bears no date, but is supposed to be as old as the year 1500 *; and, being a mere translation of a work that treats chiefly of planting and grafting, the information it conveys is otherwise uninteresting. This was followed by 'The Booke of Husbandrie,' published in 1523, with another on Land Surveying, by Sir Anthony Fitzherbert, who, although Chief Justice of the Common Pleas, was, as he himself tells us, an 'experyenced farmer of more than forty yeares,' and who has thence been considered as the father of English agriculture. The '*Booke of Husbandrie*' is not, however, so much a theoretic treatise, as an account of the rural industry of that period, and we learn from it, that many of the practices, and some of the prejudices, of the present day were then in existence. It alludes to numerous inclosures; mentions the employment of marl as a manure, together with other improvements, but does not allude to those of lime. It also contains many judicious remarks on the management of cattle, and some axioms on tillage, the correctness of which is acknowledged, even in our actual usage. It presents, however, no very alluring picture of the domestic life of the farmer of that day; for, after many prudent exhortations to thrift and industry,—it states that, 'it is a wyve's office to wynnowe all manner of cornes, make malte, washe and wrynge, make heye, shere corne; and, in time of nede, to helpe her husbande to fyll the muckwayne, or dunge-carte, dryve the ploughe, to loade heye, corne, and such other.' Fitzherbert supposes every farmer's wife to be well versed in the preparation and manufacture of flax and wool; and to the manifold duties already enumerated, besides various household avocations, he adds,—'Let thy distaffe bee alwaies readie, for a pastime, that it may keepe thee from idlenes †.'

From this and similar descriptions we are led to conclude, that the condition of the farmer was then very little superior, in point of comfort, to that of the labourer of our times; but it was far different in regard of substantial independence; for we are told by Bishop Latymer, who was born in 1480, and was the son of a Leicestershire yeoman, that although his father rented a farm of only three or four pounds a year, yet he tilled as much as employed half a dozen men, besides a walk for a hundred sheep, and that his mother milked thirty kine: out of which means he maintained his son at the university, married his daughters with twenty nobles, and was enabled to keep hospitality with his neighbours, as well as to afford some alms to the poor ‡. It is indeed probable, that the expenses of a scholar at the university did not, at that time, exceed five pounds annually, and it has been conjectured, that old Latymer was favoured in his rent §; or he may, as then customary, have paid a fine for his lease; but the mere fact, that a man of his rank should have had the ambition to give his son a

* Pegge's Life of Robert Grosseteste, 4to. p. 285.

† Booke of Husbandrie, b. iv., ch. 29.

‡ Latymer's Sermons, p. 32. The noble was a gold coin issued by Edward III., in the year 1344, at 6s. 8d., but was worth considerably more in the time of Henry VIII.

§ See Hallam's Middle Ages, 4to., vol. ii. p. 520.

learned education, affords a strong presumption of the improvement that must have taken place in the situation of the yeomanry. It proves also, that the farmer's profits must have been considerably greater, in proportion to his rent, than they commonly are at present. In corroboration of which, Tusser, who wrote about half a century later, and whose '*Five Hundred Points of Good Husbandrie*' is still read, though chiefly recommended by the quaintness of the doggrel in which it is written, and the light which it throws on the rustic manners of the early part of the reign of Queen Elizabeth, thus distributes the harvest:—

1. One part cast forthe for rent due out of hand;
2. One other part for seed to sow thy land;
3. One other part leave parson for his tith;
4. Another part for harvest, sickle, sith;
5. One part for ploughwrite, cartwrite, knacker *, and smith;
6. One part to uphold thy teams, that draw therewith;
7. Another part for servants and workmen's wages laie;
8. One part likewise for fillbellie daie by daie;
9. One part thy weife for needful things doth crave
10. Thyself and thy child the last part would have.'

The long peace which followed the accession of Henry VII. extended the sphere of civilization; the bondage in which a large portion of the lower class had been hitherto held gradually disappeared before more liberal institutions, and the general condition of the mass of the people was greatly improved. The population of England and Wales, which, in 1377, was only computed at two millions and a half, or, according to the more minute calculation of Mr. Chalmers, at 2,353,203 †, had increased, in 1575, to 4,500,000 ‡. As wealth was acquired, more capital was invested in land; rents advanced; and a proof of the progress of culture is found in a more equal proportion between the value of arable and meadow §. Many ancient parks, which had been devoted solely to the pasturage of deer, were brought under the plough ||; and small farms were consolidated to such an extent, that an act was passed early in that reign to prevent the destruction of any farm-houses to which were annexed twenty acres of land, under tillage ¶. The cultivation of hops was introduced early in the sixteenth century; and considerable attention was bestowed on the improvement of cattle. By an act of parliament, 33 Henry VIII., the nobility and gentry were bound to keep a certain number of 'stoned trotting horses, each according to their rank, the lowest of which is that of spiritual persons having benefices to the amount of one hundred pounds per annum; or any layman, 'whose weife shall wear any French hood, or bonnet of velvet.' Other statutes regulated the height of all stallions turned out on uninclosed land, in order to prevent the deterioration of the breed; but the standard shows the race to have been much inferior to the present, and even that was lowered in favour of some particular districts, among which it is not a little singular, that the counties of Northumberland and Leicester, which now produce some of our largest cattle, were included **.

* Collar-maker.

† Historical View of the Domestic Economy of Great Britain and Ireland, p. 14.

‡ Mr. Chalmers says, 5,274000. Ib.

§ According to the valuation of the monastic lands, 26 Henry VIII., the best marsh and meadow ground in Kent was only estimated at five shillings annually per acre; and the arable at an average of about one shilling and sixpence.

|| Hasted mentions fifty-three, some of great extent, and possessing rights of free warren, being disparked in the time of Queen Elizabeth, in the county of Kent only.—*History of Kent*, vol. ii. p. 271.

¶ Statute 4 Henry VII., anno 1488.

** Barrington's Observations on the Statutes, 4to. edit., 1775, p. 498. See also,

The dissolution of the monasteries, at the Reformation, was unfavourable to the farmer, for not only were the immediate tenants of the monks generally better circumstanced than those of laymen, but the tithes which fell into the hands of lay impropriators were levied with far greater rigour than when they belonged exclusively to the clergy. Agriculture, however, continued to advance, notwithstanding that, and some other impediments occasioned by impolitic statutes respecting the price of labour and provisions, and the regulation of markets; but more especially by the prohibition of the exportation of grain, while that of wool was still permitted *. These enactments cramped the operations of the husbandman; and the effect of the latter threw such large tracts from tillage into pasture, that, notwithstanding an act, passed in 1553, restricting single flocks to two thousand, Harrison, who wrote in 1577, affirms, that some persons were possessed of as many as twenty thousand sheep. Still, his sketch of the domestic habits of the farmers presents a gratifying illustration of the contrast between their enjoyments and those of the preceding age, and shows that the comforts attendant upon order and industry began to be widely diffused.

'So common,' he says, 'were all sorts of treene (*wooden*) stuffe in old times, that a man should hardlie find foure pieces of pewter (of which one, peradventure, was a salte) in a good farmer's house; and yet for all this frugalitie (if so it may be justly called) they were scarce able to live and paie their rents, at their daies, without selling of a cow, or an horsse, or more, although they paid but foure pounds at the uttermost by the yeare. Such also was their povertie, that if some one od farmer, or husbandman, had been at the ale-house, (a thing greatlie used in their daies,) amongst six or seven of his neighbours, and there, in a braverie, to show what store he had, did cast downe his pursse, and therein a noble or six shillings in silver, unto them, it was uerie likelie that all the rest could not laie downe so much against it. Whereas, in my time, although, peradventure, the foure pounds of old rent be improved to fortie, fiftie, or an hundred pounds, yet will the farmer, as another palme or date tree, think his gaines uerie small toward the ende of his time, if he had not six or seven yeares rent lieing by him, therewith to purchase a new lease; beside a faire garnish of pewter on his cupbord, with so muche more in od uessell going about the house; three or foure feather beds, so manie coverlids and carpets of tapestrie, a silver salte, a bowle for wine, (if not a whole neast,) and a dozen of spoons to furnishe up the sute †.' Yet so difficult is it to content mankind, that the same Chronicler records the dissatisfaction at this increase of luxury of the old people of his time, who especially deplored three things, that 'were marvelouslie altered (*for the worse*) in Englande within their sound remembrance'—the multitude of chimneys lately erected, and the great increase of lodgings, with the exchange of treene platters into pewter, and wooden

for a full account of these enactments, the '*History of the Horse*,' in the Farmer's Series of the Library of Useful Knowledge.

* By an act passed in 1532, the price of beef and pork was limited to a halfpenny, and that of veal and mutton to three farthings the pound avoirdupois. See Sir F. M. Eden's 'State of the Poor,' 4to., vol. i., p. 98. Subsequent statutes renewed former penalties enacted against *forestalling* and *regrating*; that is, purchasing any commodities on their road to a market, and reselling them under four miles of it. Persons who bought up corn, or other articles of necessity, with an intention of holding them for future sale, were deemed unlawful *ingrossers*; and cattle were not allowed to be sold within five weeks after their purchase. The exportation of grain was also prohibited, when the price of wheat exceeded six shillings and eightpence the quarter.—*Stat. 1st and 2d of Philip and Mary*, 1553-4.

† Description of England, b. ii. chap 12. To this may be added, Tusser's account

spoons into tin and silver. They also complained bitterly of the use of oak in building; 'for when our houses,' said they, 'were of willowe, then had we oaken men; but now that our houses are come to be made of oake, our men are not onlie become willowe, but a greate manie altogether of strawe, which is a sore alteration.' The construction of farm-houses was, indeed, much improved; for although they were still chiefly of wood and plaster, yet bricks, the manufacture of which had been either lost or neglected after the departure of the Romans, and was not revived until the reign of Richard II., became general in that of Henry VI., and were employed in building chimneys. Glass, however, was for a long time so great a rarity, that in the beginning of the sixteenth century, when the great Earl of Northumberland left Alnwick Castle for another residence, the windows were taken out, and carefully laid by *. Although common about fifty years later, yet the first mention of glazed windows, in farm-houses, occurs in a lease granted, in Suffolk, in 1615 †; and they were unusual, in ordinary country houses, in Scotland, so late as 1661 ‡. It may be added, that they are, even now, but seldom seen in the villages in many parts of the south of Europe.

That this increase of prosperity, in which the whole community partook, was the consequence of improved cultivation, is evident from the increased produce of the land; for Harrison adds, that in ordinary years, each acre, one with another, throughout the kingdom, if well tilled and dressed, would yield from sixteen to twenty bushels of wheat and rye, thirty-six of barley, and four or five quarters of oats; which, especially of the two latter, might be considered a fair average of modern crops, were it not, that the far greater quantity of poor land now in tillage reduces the general average. From what we learn from Tusser, it appears also that some improvement had been made in horticulture; for although the list which he furnishes of the plants then cultivated in gardens is still meagre, yet the number amounts to about one hundred and fifty. The field culture of roots and artificial grasses was still, however, wholly unknown, and the system of tillage, on the best cultivated land, was confined to alternate corn crop and fallow. Such, therefore, was the difficulty of maintaining cattle in a fit state for the shambles, during the severe season, that even sheep, intended for consumption, were killed and cured, on being taken from their summer pasture; and, accordingly, we learn from the household books of many persons of distinction, that down to a late period, and even in families of the largest fortune, a great portion of the winter provision consisted of salted meat. Corn-fed oxen, and sheep, are, however, mentioned so early as 1314, in an act of parliament of that year, which regulates the price of the former, when fat, at twenty-four shillings, or, if grass-fed, at sixteen; and sheep, in like manner, at twenty-pence, and fourteen pence §. That

of the usual Christmas fare of the farmers at that time, which shows the homely abundance which they enjoyed:—

'Good bred and good drink, a good fire in the hall,
Brawn, pudding and souse, and good mustard withal;
Beef, mutton, and pork, shred-pies of the best,
Pig, veal, goose, and capon, and turkey well drest,
Cheese, apples and nuts, jolly carrols to hear,
As then in the country is counted good cheer.'

Five Hundred Points of Good Husbandrie, chap. 29.

* Northumberland Household Book, pref. p. 16.

† Cullum's History of Hawstead, p. 242. Whittaker's History of Craven, p. 334.

‡ Ray's Itinerary, p. 187.

§ *Stowe's Chronicle*, fol. edit., 1631, p. 207.

stall-feeding was practised at the period of which we are treating, we also learn incidentally, from Shakspeare, to whom we should hardly look for an illustration of husbandry, were it not that his mention of the custom shows it to have been general—

> 'And we shall feed, like oxen at a stall,
> The better cherished, still the nearer death.'—
> WORCESTER, *Henry IV.*, Part 1.

From the time of Elizabeth, but little can be collected on the subject of agriculture that is worthy of notice, until towards the middle of the seventeenth century, when attention was called to the cultivation of clover, in the writings of Blythe *, and subsequently in a publication on the Husbandry of Brabant and Flanders, by Sir Richard Weston, who had resided for some years on the Continent in a diplomatic station. The advantages which are there shown to have followed the culture of that grass, attracted the notice of some industrious farmers, and, although improvements were much impeded by the civil commotions of that period, it was yet partially adopted; and, together with turnips, which were introduced about the same time, was in general use throughout the southern counties before the close of the century †. Turnips, indeed, were very early brought into use as a field crop. They are mentioned by a correspondent in Houghton's Collections on Husbandry, as well known sheep-feed, in 1684, consequently long previous to their supposed introduction into Norfolk by Lord Townshend ‡.

Towards that epoch, many gentlemen, who had been impoverished by the war, devoted themselves to farming. Cromwell was an encourager of husbandry: he allowed a pension to Hartlib, an eminent though somewhat fanciful writer, who proposed the endowment of an agricultural College; and it was during the Commonwealth that the drainage of the fens in Cambridgeshire and Lincolnshire was undertaken. Some faint attempts of the kind had been made, by a company of Flemings, so far back as the reign of Henry VII., but the present state of the Bedford Level is due to the exertions of Colonel Vermuyden, a Dutchman in the service of the Protector §. The cultivation of the soil, which had been hitherto almost exclusively confined to unlettered men, began now to interest persons of education; agriculture was no longer treated as a mere mechanic art, and several treatises were published which tended materially to its advancement. Although the present improved system of rotations was still in its infancy, yet many of our green crops were in common use before the Restoration, and Hartlib mentions the use of clover for soiling cattle; a practice, it may be observed, which, although of acknowledged utility, is even now, after the lapse of nearly two centuries, only slowly becoming general. Still, such was the deficiency of cattle food, that grass-land on the banks of the Thames, is said to have yielded nearly the same rent in the reign of Charles II. as at the present time ‖.

The writings of Tull, in the commencement of the eighteenth century, formed a remarkable era in the progress of agricultural science, on which they ultimately conferred a lasting benefit, although the injury which his fortune sustained from some of his speculations, for a long time deterred others from the adoption of that portion of his plan which was

* See 'The Improver Improved,' by Walter Blythe, 1652, part ii. sec. i.

† Aubrey's Survey, vol. iii. p. 229.

‡ Houghton's Collection of Papers, vol. i. p. 213; vol. iv. p. 142, 144. Second Edition, 1728.

§ Narrative of the Great Level of the Fens, by Sir Jonas Moore, Knt., F R.S.

‖ Mavor's Survey of Berkshire, p. 235.

have not yet been brought sufficiently into use. About the same period, the valuable addition of the potato was made to field culture, and was followed, at a considerable interval of time, by the Swedish turnip, and mangel würzel, together with a useful variety of wheat, which comes to maturity though sown in the spring: but it is only within these few years that the chemical tests carried on at Woburn, under the direction of Mr. Sinclair, have made us acquainted with the relative qualities of the field roots, and of natural and artificial grasses *; or that the writings of Kirwan, Cavendish, and Sir Humphry Davy, have taught us a more scientific knowledge of the properties and application of manures.

Bakewell did not begin his experiments on live-stock until about 1760; and Mr. G. Culley's well-known Essay on that subject—which was the first practical account of the principles on which they were conducted—did not appear until 1786. To the efforts of these, and other eminent breeders, too numerous to particularize, and to the patronage of the late and present Dukes of Bedford, Lord Somerville, Mr. Coke, and some other distinguished promoters of agriculture, we are indebted for the high state of perfection which a great portion of our cattle have attained; to which, also, the numerous Agricultural Societies, and, above all, the Smithfield Cattle Club, have essentially contributed. It has, indeed, been ludicrously objected to the latter, that the animals exhibited at their annual show are—

'Too dear to buy, too fat to eat,'

and an impression has gone forth, that the premiums conferred on the feeders have been injudiciously bestowed. But the object in view is not the promotion of such a system of feeding as shall bring cattle, generally, to that condition; it is to ascertain what breed will the soonest, and with the least and most unexpensive food, become fit for the shambles; and the prize is not awarded to that animal which is the fattest, but to that which is the most profitable to the grazier. There is still, however, much room for improvement. In many whole districts, no attention whatever is paid to discrimination of breed; consequently, much inferior stock remains scattered throughout the country; and although, when brought to market, such cattle invariably fetch less money than those of the improved kind, yet are they upheld through the indolence, the ignorance, and the prejudices of many farmers, to their own manifest loss, and to the injury of the community. Nor can it be denied, that some of the experiments which have been made, have not been attended with complete success. It has been found, in many instances, especially in sheep, that while the bone and offal have been reduced, the animal has been rendered more tender than formerly; and although the general advantage which has resulted from crosses with the new stock must be acknowledged, yet some breeders are now as anxious to avoid all mixture of the Dishley blood, as they formerly were to obtain it †. It appears also by the chief tenor of the evidence before the Committee appointed by the House of Lords to inquire into the state of the British wool trade, in 1828, that the attempts to improve the carcass of the fine-woolled sheep have had a contrary effect upon the fleece; but the quantity of mutton has certainly been increased,—and therefore, to the grazier, it is mere matter of calculation whether the profit on the one counterbalances the loss on the other: to the public, there can be little doubt that the change has been advantageous. See *Supplementary note No. 1.*

The agriculture of Ireland possesses but little interest. The country remained for ages almost in a state of native pasturage, to which the humi-

* See Sinclair's *Hortus Gramineus Woburnensis.*

† See Price, on the Romney-Marsh Sheep.

dity of the climate is peculiarly favourable; and a great portion of the soil consisting of a rich loam upon a limestone bottom, it contains some of the finest grazing land in the United Kingdom. But, with these advantages, its husbandry has always been imperfect; and even at the present day, with very few exceptions, there is scarcely to be found throughout the island, a farmer living exclusively by his business, who cultivates so much as two hundred acres of arable ground. The chief part of the tillage is in the hands of small tenants who hold the plough themselves, and whose general want of means precludes the introduction of machinery, or the adoption of any plan that occasions additional expense. Some landed proprietors farm a portion of their own estates; but the wealthy yeomanry, who form so respectable a class in this country, are there utterly unknown. There are immense tracts of the richest pasture in the hands of graziers, some of whom are men of very large property. Mr. Young mentions two, in the county of Tipperary, one of whom farmed 13,800 Irish—equal to 22,350 English acres—on which he had a stock of 16,300 sheep, 3000 head of black cattle, and 300 horses; and the other held 9000 acres, at a rent of 10,000*l.* per annum, so far back as the year 1777 *. But the system of grazing is mostly confined to natural grass: except by a few amateur gentlemen farmers, stall-feeding and artificial food are but rarely resorted to; and there are many very considerable stock-masters who have not an acre under tillage.

The various insurrections with which the country was distracted from the time of its conquest in the reign of Henry II., prevented any permanent improvement in cultivation until that of James I., when the whole of the northern province of Ulster escheated to the crown, and the immense possessions of those who were implicated in the rebellion of the Earl of Tyrone were granted to '*undertakers*,' as they were called, much in the same manner as land is now disposed of in Canada and Australia. A large portion of these forfeited estates was allotted to the church; and the chief part of the remainder, to the twelve principal corporations of the city of London, who were bound, by the conditions of the grant, to colonize the country with Scotch or English tenants; a small part only being reserved for the Irish freeholders †. The larger number of colonists were Scotch, and, from their known industrious habits, great expectations of advantage were formed from this '*plantation of Ulster.* But agriculture was, at that time, at as low an ebb in Scotland as in Ireland, and the plan was not attended with any material benefit to the soil. The new settlers applied themselves to the manufacture of linen, which still forms the staple branch of industry in the north of Ireland; but the weavers, instead of being crowded together in towns, as customary in the manufacturing districts of England, occupy cottages in the country, to which a few acres of land are attached, and thus, combining the profit of the loom with the advantage of the crop, they enjoy a superior degree of comfort. Many of them have ground enough to be considered as small farmers, and as they are generally a laborious class, inheriting much of the prudent economy of their ancestors, the quarter in which they reside wears an appearance of greater order and neatness than are observable in other counties; but the system of farming, on a larger scale, is not generally superior to that of the rest of the island.

Much of the land confiscated in the subsequent civil war, and bestowed upon the officers of Cromwell's army, fell to the lot of men well-acquainted

* Arthur Young's Tour in Ireland, 4to. p. 320.

† Harris's Hibernica, pp. 105, 125.

with the better mode of English farming; but they had to contend with the prejudices of the natives, whose habits they gradually adopted, and though many of their descendants possess considerable estates, they are not remarkable for any superiority of management. The jealousy, or the distrust of Ireland, entertained by the English government at that, and a long successive period, threw impediments in the way of her agricultural prosperity, that are felt at this hour. Not only was she deprived of her woollen manufacture, but by an act passed in the reign of Charles II. the importation of her cattle into this country was prohibited. The employment of capital in that species of industry best adapted to the soil and habits of the people was thus repressed; and although the ill effect of that measure was partially remedied by the monopoly which she afterwards obtained of the salted provision trade, as well as by an act passed in the reign of George I., exonerating pasture-land from the tithe of agistment, yet other impolitic legal disabilities prevented a large portion of the community from embarking their property in land.

A slight impulse was given to Irish agriculture by the establishment of the Dublin Society for its encouragement, in 1737, with a parliamentary grant of 10,000*l.* per annum. If properly seconded, this might have been made a powerful instrument in raising the husbandry of the country from the depression under which it laboured at that period, and the society has done more in the distribution of premiums and various efforts for its improvement than has ever been attempted by any other farming association; but the exertions of the Board were rendered in a great measure abortive by the ignorance and the want of capital of the farmers, and the indifference of the landlords to the means, character, or industry of their tenants. 'Farms are commonly let by auction; the highest bidder is invariably preferred; and if he can but pay his rent, no inquiries are made whether he cultivates the land in a proper manner, or ruins it by exhaustion *.' Many of the leases are upon lives, to middle-men, who select as much of the land, at rack rents, as will allow them to 'sit clear,' as they phrase it, and the children of the sub-tenants are settled upon divisions of the father's portion of the farm; by which means, the ground is at length parcelled out into small patches, among a set of cottiers, who subsist upon the potatoes which they grow, with the addition of a pig, and sometimes of a cow. Some legislative measures have lately been adopted to check this custom of sub-letting, but it has already spread a race of pauper-tenantry over the land, and nothing but the application of additional capital to the cultivation of the soil, with the reclamation of the bogs and wastes, can effectually cure the evil. Large tracts are in what is there called '*mountain;*' but the term is applied to all waste land on which young cattle and sheep are fed until they are fit to be sent into the richer pastures of Limerick, Tipperary, Roscommon, and Meath, which, with some parts of Cork, Waterford, and Clare, are the chief grazing counties. The bogs are not all low-land; much of the mountain consists of that kind of soil, and there is some very elevated ground in the great bog of Allen.

Of the state of farming in that country, within the last thirty years, the very able surveyor of Kilkenny says,—'that mode of cultivation is, indeed, too well known in Ireland, by which a soil naturally fertile, but exhausted by repeated crops of corn, is abandoned to noxious weeds for several suc-

* See Wakefield's Statistical View of Ireland, 4to. vol. i. p. 304, and the Agricultural Surveys of Ireland, *passim*.

ceeding years: is again broken up, slightly manured, exhausted, and again abandoned; where culture, instead of improving, deteriorates; where no effort is made for permanent utility; where every operation of the farmer, and every work of the farm, is just calculated to meet the present necessity, and no more; and where the different branches of rural economy, so far from assisting each other, remain unconnected and distinct, in a state of unnatural repulsion.

'The houses of rich farmers are generally far inferior to their means, and are such as exempt them from the window tax, and often from hearth-money *. But the great failing is in the offices: the barn is generally a shed to thrash in, with no floor but the natural soil; the stable, a hovel; a cow-house is often not to be be found; no yard is appropriated to pigs; the corn-stands alone mark the farm. A shed to protect the implements of tillage was never thought of; the richest farmers always leave the plough and harrow in the corner of the last field they tilled; such parts of the harness as may not consist of *gads*, or *sugans* (strawbands), are secured in the house; and with the smaller farmers, if the car does not stop some gap, called a gateway, it may lie against the ditch or the dunghill †.'

This picture may perhaps be somewhat overcharged; and considerable improvement has since taken place; but it has been principally directed to the live stock. The tillage, though somewhat amended, and greatly increased since the act, commonly called Sir John Newport's, in 1806, allowing the free importation of grain into this country ‡, still bears striking evidence of deficient capital and slovenly management; nor has it yet been carried to such an extent as to warrant the supposition that Ireland now yields anything approaching to her powers of production, except in her cattle, towards the perfection of which it must be admitted that great efforts have been made. The culture, indeed, seems to be in an inverse ratio to the fertility of the soil, and it is to be feared that, throughout a large portion of the island, the system still forms the rule, and the improvement the exception.

Of early Scottish argriculture, there is little worthy of record. It was, until within the last century, far inferior to that of England, and the condition of the farmers and the peasantry was proportionably wretched. The union of the crowns on the demise of Queen Elizabeth was considered, at the time, as unfavourable to its progress, in consequence of many great proprietors becoming absentees during their attendance on the court; but so many of them returned with additional wealth that ultimately it no doubt had an opposite effect. The first step towards its improvement, was an act passed in the time of Charles I., by which landholders were empowered to have the tithes of their estates valued, and to purchase them at a fixed rate; to which, and the salutary measures adopted for the support of the poor, its subsequent advancement may chiefly be ascribed. It was, however, for a long time in so low a state, that the expenditure of Cromwell's army actually raised the rents, in the districts in which it was quartered, higher than they were half a century afterwards. Although

* 'Hearth-money' was a tax (since repealed) on fireplaces, from which cottages having only one were exempt.

† Tighe's Stat. Observ. relative to the County of Kilkenny, 1802. Curwen's Observ. on the State of Ireland, in 1813. Survey of Clare, pp. 144, 152.

‡ The report of a Select Committee of the House of Commons, appointed to inquire into the state of the Corn-trade in 1813, states the increase of produce through the improvement and the extension of cultivation in the previous ten years, at about one-fourth of its former amount.

that depression is partly attributable to the oppressive fines by which the country was impoverished in the following reign, it yet must have been chiefly caused by the defects of cultivation. It received a powerful impulse from the union of the two kingdoms, in 1707, which, by removing many impediments that previously existed to commercial intercourse with England, encouraged the application of additional capital to the soil. To this succeeded the act, passed after the rebellion of 1745, abolishing the heritable jurisdictions, by which the tenantry had been much harassed; and another, equally salutary, in 1770, enabling the possessors of entailed estates, to raise money for the improvement of the property, and to grant leases for definite periods, extending beyond their lives. Great advantage was also derived from an enactment, granting a power of dividing commons by an application to the Court of Session; as also from a law which constitutes the march or boundary between two estates, the property of each, and confers upon one proprietor the right of compelling his neighbour to contribute to the erection and maintenance of the fence. Thus stimulated, cultivation made such rapid progress that, within less than half a century, the corn raised on waste land alone was supposed to be equal to one-sixth of the former produce of the entire kingdom. It appears also, from the '*Transactions of the Honourable Society of Improvers in the Knowledge of Agriculture in Scotland*,' published in 1743, that lucerne and sainfoin, though still but little cultivated in that country, had been already introduced; and that the turnip, cabbage, and carrot husbandry had partially superseded summer fallows in the Lothians. The culture of potatoes, however, though mentioned in the '*Husbandry Anatomized*' of Donaldson, so early as 1697, was but little known; and some idea may be formed of the mode of farming which then prevailed, from a letter in the former publication recommending them to notice, the concluding eulogium of which says, 'In good ground, you may have after them—first, a crop of wheat, and then a crop of barley, and after that a crop of oats, and then potatoes again!'

The value of the alternate system had not then, indeed, been clearly defined, and the rotation of crops was consequently defective; the nature of manures was not well understood, and the views of the farmers were as narrow as their circumstances. Much of their land was held in what is termed '*run-rig*,' similar to the common-field of England, and was usually divided into *infield* and *outfield*, of which the former, being the nearest to the *steading*, (as the house and offices are called,) and generally the smallest portion, absorbed the chief part of the manure, and sufficient capital was still wanting to give due effect to the new practice. Even when these obstacles had been in some degree surmounted, the unavoidable mistakes that occur in the first attempts at innovation, often involved those who undertook new experiments in disappointment, which nourished the prejudices of the farmers and labourers; and, not fifty years ago, the husbandry, even of those counties now most remarkable for its superiority, remained in a very backward state. It is unnecessary to detail its progressive advance to the high rank which some parts of the country have now attained in the scale of agriculture; but much as has been already done, there is yet ample room for improvement even in the most favoured districts, and there are many where cultivation is still in its infancy *. A vast range of upland is

* The tillage of a great portion of the Hebrides, in 1811, is thus described in the agricultural survey of those islands. 'A man walking backward with his face towards four horses abreast, brandishing his cudgel in their noses and eyes, to make them advance to their enemy, followed by a ristle-plough employing a horse and two men, the

either wholly waste, or devoted to the support of a few half-starved cattle, and the maintenance of an indolent peasantry who barely obtain a scanty and precarious subsistence from the soil, with little benefit to themselves, their landlords, or the country. Of this, the greater part might be profitably converted to the rearing of sheep, which should be the chief object of the husbandry of those pastoral regions. The herbage is better adapted to that than to any other stock, and they can be supported during the winter with very little assistance from the plough, while, such is the difficulty of procuring food at that season for the cattle fed on the hills in summer, that they often perish in great numbers, notwithstanding the barbarous precaution of killing every second calf in order to prevent their too rapid increase. Strangers to the Highlands, and interested tacksmen, have declaimed pathetically on the cruelty of removing the cottar tenants to make room for sheep; and a senseless outcry was raised upon this subject some years back, when that measure was enforced upon the Sutherland property. But it is impossible to read the interesting narrative of that transaction, as detailed by the confidential friend and adviser of the noble owners, and to find, that the tenants, instead of existing in idleness under the bare shelter of turf huts, and exposed to the frequent recurrence of famine, have been settled upon the coast in comfortable cottages and thriving industry, while an immense tract of hitherto comparatively unproductive country has been made to contribute largely to the general prosperity, without being convinced of the important benefit that may yet be derived from the extension of the same system *; nor to view the report of Mr. Sellar's admirably conducted farm upon that estate, at the northern extremity of the kingdom, without being struck with the extent of individual advantage that arises from the pursuit of husbandry, when prosecuted with intelligence and persevering industry †.

Of the comparative merits of Scotch and English husbandry, we may safely adopt the recorded opinion of a gentleman better qualified than perhaps any other man in the kingdom, by extensive acquaintance with the agriculture of both countries, to form a correct judgment on the subject. He ascribes to the former a superiority in the execution of the tillage, and greater activity of management; with, however, less attention than is shown in England to the general cleanness of the crops, or the care of grass land: and he adds, that, 'the rapid success in improvement so visible in certain districts in Scotland, has led rather too rapidly to the conclusion, not only that the Scotch are decidedly better farmers than their English brethren, but that the latter are, in fact, but indifferent husbandmen. Nothing can be so totally without foundation. That a considerable portion of England might be better farmed than it is, may be true, but it would be a matter of astonishment, in a country cultivated as this country is, from one end of it to the other, if much indifferent farming did not prevail. There is no country where so many valuable practices exist; many un-

three commonly altogether superfluous, still followed by four horses dragging clumsy harrows fixed by hair-ropes to their tails, and amost bursting their spinal marrow at every tug and writhing of their tortured carcasses; all this cavalcade on ground uninclosed, undrained, and yielding at an average three returns for the seed sown, and sometimes lost altogether by the depredations of cattle, or by accidents in a late harvest.'—*Macdonald's Survey*, p. 178. The same author also states that much of the most laborious and degrading work, such as carrying burdens of manure, and peats upon their back, is performed by females, p. 112

* See 'An Account of the Improvements on the Estates of the Marquess of Stafford, by James Loch, Esq., M.P.

† See No. 18 of the 'Farmer's Series' Library of Useful Knowledge.

known to the agriculturists of the north, and well worthy of their consideration and adoption *.'

Such was the state of agriculture throughout the United Kingdom towards the close of the last century, when the stoppage of payment in coin by the Bank of England, in 1797, and the consequent unlimited issue of a paper currency, afforded unprecedented facilities for the creation of trading capital. Speculation was immediately afloat upon every object that afforded a chance of profit: every article of consumption soon bore an artificial value; and the extraordinary high prices of grain in the years 1800 and 1801, and from 1809 to 1813, naturally turned the attention of the public to farming. Specious schemes and flattering calculations induced many, who were wholly ignorant of the practice of husbandry, to stake their property on that venture, and even many old farmers, too, deluded by the apparent prospect of sudden wealth, imitated those speculators in the extent, and too frequently in the wildness, of their projects. The tables of Parliament were loaded every session with numberless inclosure bills; land which had lain time immemorial in pasture was broken up; and that already in tillage was forced by stimulating manures, and exhausted by repeated cropping. The landlords and the clergy took the advantage to which they were entitled of the general rise, and advanced their rents and tithes accordingly; the taxes for the support of the war accumulated upon the land; and when at length a new order of things took place at the peace, and the return of cash payments reduced produce from its fictitious value to the standard of a metallic currency, the farmer was, notwithstanding, left to pay in gold those engagements he had contracted in paper, and that ruin followed from which agriculture received a check that it has not yet recovered. It must, however, be admitted that the impulse given to cultivation extended the knowledge of the art; and that although much valuable old meadow was destroyed, and a great deal of arable seriously impoverished, yet, at the same time, many useful improvements were introduced, and agriculture flourished beyond any former period.

That high prices were the cause of the rapid progress of cultivation in the commencement of the present century, there can be no doubt; but the affluence of the farmers, at that time, arose rather from the employment of additional capital, and the additional produce which an improved system of husbandry enabled them to raise, than from the increased value which that produce bore. At first, those who were already in possession of leases, calculated upon former prices, profited largely; and others, who were acute enough to seize the opportunity, and prudent enough to secure its advantages, were equally fortunate. But gradually the farmers' expenses increased in so exact a proportion to the increase of prices, that it appears from the report of the Corn Committee of the House of Lords, in 1814, that the charges of cultivating one hundred acres of arable land, which, in 1790, amounted to 411*l.* 15*s.* 11*d.*, had risen, in 1803, to 547*l.* 10*s.* 11*d.*; and in 1818, to 771*l.* 16*s.* 4*d.*; which sums bear nearly the same relation to each other, as each average price of wheat during the same periods. The estimate was made from an average of charges transmitted from various parts of the country; and it is worthy of remark, that each separate head had increased almost minutely in the same ratio †. In fact, whatever exceptions may occur, through peculiar circumstances, to affect the general rule, the aggregate farming capital of the kingdom leaves a certain per centage profit upon an average of years; consequently, the

* Mr. Loch—'Appendix to the Account of Improvements on the Estates of the Marquess of Stafford,' p. 38.

† See the Minutes of Evidence, p. 65.

larger the capital employed, the larger will be the profit, although the per centage remains the same; and therefore, every increase of common expense that occasions the application of additional capital, also increases the general gain,—while, however, the proportion of that gain which may fall to the share of each individual farmer, will depend upon the judgment and skill with which his expenditure is managed, as well as upon the amount of his portion of the common stock; and this leads to the important consideration of the knowledge that is requisite to ensure complete success.

All judgment is comparative. One man, with only sufficient for the common conduct of his business, may succeed tolerably well; but another, of superior ability, makes a fortune. This applies to every one; but to no one with greater force than to the farmer. In every trade and manufacture, there are certain rules by which persons in the same line are nearly equally guided, and in all which they are instructed during their apprenticeship; but husbandry is an occcupation of boundless variety, extending to more objects, and fettered by fewer positive regulations, than any other. Not only do different systems prevail in different countries, but in different provinces of the same country; in some they are dictated by peculiarity of soil or climate, while in others, they have arisen out of local habit, or they spring from improvements that have not been generally disseminated, and even in the rudest districts there may be some which merit imitation. Now it is quite evident, both that some of those systems must be preferable to others, and that no man can determine which is best without being acquainted with all; nor can any farmer be said to be completely master of his business, until he has attained that knowledge. It is not sufficient that he already gets what he considers a fair return for his capital and industry, if by other modes of culture he could obtain more; and if he neglects them, he injures himself, his family, and the public. He may be satisfied with thirty bushels an acre of wheat; but if by any other method, not more expensive, he can grow thirty-one, it is not alone his interest, but his duty also, to adopt it. In no country has husbandry been carried to higher perfection than in this; yet, even in England, practices exist in some counties, that are either wholly unknown or only imperfectly understood in others, and it is only by comparing them that their relative usefulness can be ascertained. Farmers, being necessarily much confined to their own district by the unremitting care which their business demands, can rarely inspect the system of any other; and, therefore, improvements that, when made in manufactures, are speedily promulgated in consequence of their usually close neighbourhood, are only slowly disseminated among husbandmen. *See* Supplementary Note, No. 1, post.

With a view to remedy that inconvenience, and, through authentic details of every branch of rural economy that was deserving of notice in all parts of the country, to enable every man to acquire that information which was impracticable by personal inspection, a Board of Agriculture was established by government, in the year 1793, under the presidency of Sir John Sinclair, with the late Arthur Young as secretary, whose names alone are a sufficient guarantee for the zeal with which its labours were conducted. These were chiefly directed to the arrangement of accurate agricultural surveys of every county in the kingdom, which being completed in 1813, the object of its institution was considered to have been accomplished, and it was dissolved. These surveys were made by able men of business, among whom were many eminent practical farmers; they acted under the sanction of the Board, and the influence of its supporters, and, thus aided, the best sources of information were opened to them in those counties to

which their inquiries were respectively directed. They were made, too, during a period of unequalled agricultural prosperity, when abundant capital and enterprise brought into action every known means of improving the soil, and consequently, when the information to be obtained was of the most valuable kind. They had access to all the most experienced persons in every line of husbandry; and, having viewed their farms, and noted down the details of whatever was worthy of remark in their mode of management, together with their own observations, all this was printed and circulated throughout the country for further comment, after which, the whole was embodied, and the report, after being finally corrected, was published. Nothing could be better imagined, or, in most instances, better executed, for the accurate attainment of the object of inquiry; yet one step more was wanting to render it generally useful. The researches of the surveyors having been directed to the same points in every county, and to many of a purely statistical nature, regarding their extent, population, and resources, the reports necessarily contain a vast mass of repetitions, and of matter of mere local interest, of no value whatever to the husbandman, mixed up with that which is really useful. They are, besides, exceedingly voluminous and very expensive, and are thus not only beyond the reach of most farmers, but it would occupy too much of their time to separate and compare that portion of their contents which might be of service. They should, therefore, have been reduced into one condensed report of the whole collective agricultural information alone, without reference to any other subject; which has, indeed, been partially attempted in the 'General Report of Scotland;' but the retention of the statistical matter, and the weight of five bulky volumes, leave it open to nearly the same objections as the original surveys.

In order to remove these defects, and to present a summary of the husbandry of the whole kingdom—embracing Ireland and Scotland as well as England—within a small and unexpensive compass, the work which is intended to form the subject of the succeeding numbers has been undertaken. Its object being simply to communicate the results of real practice, unincumbered by any speculative reasoning, it will be exclusively confined to the details of actual management, whence the experienced farmer may draw his own conclusions, and in which the less skillful will find safe practical instructions for his guidance. The extent and variety of the subject preclude the expectation of its being perfect; but a confident hope may be entertained that it will be found useful. The proposed arrangement will differ from that of the surveys, inasmuch as, instead of giving an account of the agriculture of each separate county, the information collected from each will be embodied under the different heads to which that information refers. Thus one portion of the book will be devoted to tillage, another to grazing, and a third to the dairy, &c. &c.; and in each of these will be found, under distinct titles, all the particulars of the common modes of management, and the varieties of practice that occur; so that a person who wants to know the system of cropping any particular soil, or the different methods of cultivating any specific crop, or of fattening cattle, or any other object of husbandry, may be enabled at once to compare the customs of every part of the country, where any difference exists, and to judge from the result of each, what may be the best suited to his own soil and circumstances. Nor is it meant to limit the work to a mere summary of the county surveys: other authorities of established reputation will be consulted; wherever subsequent improvements have been made, they will be noticed; and authenticated particulars of any recent experiment, or ob-

servations, or of the invention of any novel implements, that appear to merit attention, will be faithfully recorded. It will thus consist of a plain and comprehensive, though brief, view of the real practical agriculture of the United Kingdom, divested of all theory, and of those dissertations which, however plausible and ingenious, more frequently perplex than instruct the unlettered reader.

The degree of credit to be attached to a publication of this nature, must be estimated by the reputation of those by whom the great body of information from which it is compiled has been collected. Its utility may be judged by the indisputable fact, that no man, whatever his experience or ability, can boast that he is master of every branch of husbandry; and, even in those to which his experience may extend, there is no one who has not yet something to learn. There is no class who place more entire reliance on their own skill than farmers, yet they who know them best will be the most ready to admit, that the greater number are far from having acquired a correct knowledge of their business; and no one, who is acquainted with the general agriculture of the country will assert, that it has yet reached the degree of perfection of which it is susceptible. Regarded nationally, the intent of cultivation is to obtain the greatest possible amount of produce from the soil; the farmer's object is to raise it by such means as will afford him the largest profit, and there can be no doubt, that the more scientifically he proceeds, the more effectually will both objects be gained. Capital and labour form the basis of agriculture; both abound in this country, to an extent unknown in any other, and unequalled at any former period; our climate, if not equal to some, is superior to most, for the production of all articles of common necessity; and the progress we have made within the last century, instead of satisfying our exertions, should only stimulate us to still further improvement.

The protection which the legislature may, in its wisdom, deem it right to afford to agriculture, is a question of political economy that does not fall within the scope of this publication; neither is it meant to advocate any peculiar species of cultivation; but, as a general observation, it will, perhaps, be found—that the interest of both landlord and tenant, with a view as well to immediate profit as to the future productiveness of the soil, will be best consulted by an extension of the present alternate system, to a still further repetition of the green-crops on light soils; by the return of much of the land now under the plough to a state of permanent grass; and, as arising out of that, by an increase of the dairy husbandry, for which the greatest encouragement is obvious in the constant demand of our markets, notwithstanding large importations from Holland and the Netherlands *—while it is also one of the most certain as well as one of the most lucrative branches of farming,—one of the most ameliorating to the land,—and offers, to the extent to which it may be substituted for the production of grain, the surest means of counteracting any ill consequence to agriculture that may be apprehended from the importation of foreign corn.

* The amount of foreign dairy produce, exclusive of Ireland, imported into the port of London alone, in the years 1830 and 1831, was

	1830.	1831.
	Cwt.	Cwt.
Butter	106,574	123,669.
Cheese	61,414	134,461.

MEMORANDA.

As all the measures referred to in the County Surveys, and other books, to which reference must be frequently made in the course of this work, are of the old standard, and their reduction into imperial measure would occasion much unnecessary trouble and some confusion, the calculations will be retained in the former Winchester gallon, bushel, and quarter.

The weights of cattle will be per stone of 14 lbs. live } weight.
ditto 8 lbs. dead }

or per score of 20 lbs.

,, of wool per lb., or per tod of 28 lbs.

The measurement of land will be computed by the English statute acre of 160 perches or poles, of 16½ feet each, or 4840 square yards; bearing the proportion, in nearly round numbers, of 4 to 5 to the Scotch, and 3 to 5 to the Irish acres, which severally consist of 6150 square yards to the former, and of 7840 to the latter.

Dung, when not otherwise estimated, will be calculated by the ton of 1 cubic yard, or 27 cubic feet to the one-horse cart, or of 50 cubic feet to the common waggon-load.

The technical terms must necessarily be those used in the counties of which any particular practice may be detailed; but a Glossary of common provincial husbandry phrases will be given in the Appendix, which will also contain the botanical names of the plants mentioned in the work, together with some useful tables and forms for common purposes.

CHAPTER I

ON HIRING AND STOCKING A FARM—SIZE—CAPITAL—EXPENSES AND PROFITS

Few agricultural subjects have occasioned more controversy than that of the proper Size of Farms. There can be no doubt that large farms admit of the most economical and scientific arrangement, and afford the greatest scope for improvement: it is also obvious that men of property and education will not be satisfied with inconsiderable holdings, and that it is materially the interest of landlords to accommodate a wealthy and improving tenantry. It is not therefore to be wondered at, that many small farms were laid into one during the late war, when large capital was invested in agriculture; nor can it be denied, that both the means and the views of those who rented them were generally narrowed, and that they were more remarkable for industry than for intelligence. But although it be granted that extensive farms are proportionately the most productive, and therefore—in the opinion of those economists who view husbandry only as it is the means of procuring food—more nationally useful than those upon a small scale, there are yet other considerations of equal, if not of superior importance, which those who also regard the moral welfare of society, and who in their search after abstract truths do not lose sight of existing realities, will not leave wholly out of mind. These, however have more claim upon the attention of philosophers and statesmen, than of farmers, and are rather questions of speculation than of fact; for neither landlords nor tenants are influenced by any other motive than their own interest, and no one either leases or rents a farm merely to benefit the public. It may be assumed, as an axiom of political economy, that the mode of occupation which enables the tenant to pay the highest rent must be the most beneficial to the community; yet, as every man has a right to employ his capital as he pleases, and as, on this point, as well as on every other, each will naturally endeavour to suit his own convenience, the discussion is useless to any practical purpose. We shall therefore only observe that no *arable farm*—in the proper acceptation of the term, being worked by the plough, and unconnected with any other business from which assistance may be derived in its cultivation—can be carried on with due profit to either the occupier, the proprietor, or the public, unless it be of such extent as to afford constant employment to a team of cattle of sufficient strength for its effectual tillage. Dairy farms are differently circumstanced: although most profitable when combined with tillage, they are not necessarily connected with it, nor are they required to consist of any definite portion of ground; they possess the advantage of supplying occupation to females, and in some pastoral districts, many families subsist in decency and comfort upon the produce of a few acres.

Any attempt to limit the size of farms would be not only vain, but injurious. The interests of society demand that the fullest scope should be afforded to the industry of every man, be his means what they may, and

whether equal to the cultivation of a hundred acres, or of a thousand, room should be allowed to his exertions. It is, however, generally found, that from three hundred to five hundred acres of tillage, with a fair proportion of meadow, and of a medium soil, are sufficient to occupy the most experienced husbandman; besides that the quantity of land which, in larger holdings, must necessarily lie at an inconvenient distance from the homestead, occasions a proportionate waste of labour. Much, no doubt, depends upon the nature of the land; more on the ability and attention of the man; but, in any case, if he take more land than he can himself superintend, without any other assistance than that of a working bailiff, he is rather to be considered as an agricultural speculator, than as a farmer, and it might be often advantageously borne in mind, that 'if fifty acres make many a pauper, a farm of a thousand makes many a bankrupt.

Tillage Farms are the most profitable to the community, because they give employment to the greatest number of persons, and are the most productive of human sustenance; for although the quantity of fodder used for the support of the cattle employed in cultivating them must be deducted from their produce, and the remainder is all that is available to man, yet that will exceed the largest amount of human food that can be obtained from an equal number of acres of the same soil, under pasture. In a private point of view, however, grass-land, when of good quality, is of the greatest value, because it produces an abundant crop without the expense of cultivation. It is, also, for that reason, a more secure investment to landlords; and, therefore, unless when seduced by an extraordinary high price of corn, they rarely allow such land to be broken up. But in point of convenience, of general profit, and of pleasure, a farm composed of both arable and pasture is to be preferred to one consisting of either alone.

It is still an undecided question whether farms of a mixed soil are preferable to those of one equal quality. The advocates of the latter urge the advantages attendant on a uniform system, fewer implements, and the consequent greater ease and economy of management; while the supporters of the former insist on their superiority in affording a wider range for experiment, a greater variety of crops and seasons, and a better division of labour and hazard; remarks which apply with peculiar force to stiff clays, on which the teams must remain idle during many days on which they might be employed on land of more various quality. 'A kind soil,' it has been justly observed, 'is an exhaustless source of amusement to the rational possessor; an untoward one, the plague of his autumns—the pest of his winters—and the never-failing curse of spring †:' to which it may be added, that bad land is dear at any price. By *bad land*, however, is not meant *poor land*, from much of which, when of a kindly nature, money is to be made under proper management; but cold and wet clay and gravelly soils should be carefully avoided; for although subject to heavy and constant expense for drainage, and of a difficult tillage, they are uncertain in their returns, and only fit to be laid down to grass. Rich soils are scarce, and not easily obtained, but a sound hazel loam, though not of the first quality, yet if deep enough not to be easily affected by drought, and both dry and friable enough to work kindly in the early part of spring, will seldom disappoint an active and intelligent farmer.

The choice of a farm is an object of the deepest importance to the man who depends on it for subsistence · but it is only rarely that he can

* Rowland Hunt: Communications to the Board of Agriculture, vol. i. p. 59.
† Marshall: Minutes of Agric. Digest, p. 19.

select such a one as would prove in all respects desirable. Yet, although in most instances the competition for land may compel him to take what he can get, rather than what he would choose, there are still considerations which no one of common prudence can overlook. The nature of the soil, and its actual condition; the situation, with respect to roads and markets; the compactness of the inclosures; the state of the buildings and fences; the tenure, both as it regards the duration and the covenants of the lease; the rent and assessments; the cost of essential improvements, and the price of labour, are each deserving of serious reflection: in the aggregate they determine the requisite amount of that which demands the most especial attention, namely—

CAPITAL.

Most farmers are anxious for large occupations, and many are thus betrayed into the error of renting a greater quantity of ground than they have the means of managing to advantage: some, in the delusive hope of acquiring those means by future savings; others, from the vanity of holding more land than their neighbours. Hence arises deficiency of stock, imperfect tillage, and scanty crops, with all the consequent train of rent in arrear, wages ill-paid, and debts unsatisfied—distress, duns, and final ruin. Whereas he who is prudently content to commence with only such a number of acres as he has the power of cultivating with proper effect, is certain of obtaining the full return from the soil; while, not being burdened with more land than he can profitably employ, his engagements are within his means, and thus, while enjoying present ease of mind, he lays the surest foundation for his future prosperity.

There is no mistake more common, nor more injurious, than that of supposing that the more land a man holds the greater must be his profits; for the profit does not arise from the land itself, but from the manner of using it: the best soil may be made unproductive by bad management, while the worst may be rendered profitable by the opposite course; *but without sufficient capital no land can be properly cultivated.* There is nothing to which capital can be applied with greater certainty of a fair return for its liberal expenditure, when correctly employed, than land; but, on the other hand, there is nothing more ruinous, when the capital is either insufficient, or injudiciously laid out. In fact—assuming always that the expenditure be directed with judgment—it will be found that the profit upon the outlay increases in more than a proportionate degree to its amount: thus, supposing five pounds to be the lowest, and ten the highest sum that can be employed in the common culture of the same acre of land, it is more than probable that, if the five pounds return at the rate of ten per cent., the ten will yield twenty, or any intermediate sum, at the same progressive ratio. Now, admitting that to be true—and it is presumed that no experienced agriculturist will doubt it—it follows, *that 1000l. expended in the cultivation of 200 acres will only yield a profit of 100l., while, if applied to no more than 100 acres, it would produce 200l.*; wherefore, although a farmer of limited capital may not be driven to the extremity we have already supposed, and although he may be able to carry on his business with a certain degree of advantage, it is yet evident that his profit would be increased by diminishing the quantity of his land. Many a one has been ruined by a large farm who might have acquired a competency with one of half the size. It therefore behoves a man to weigh well the charges with his means, and not allow himself to be seduced by any ideal prospect of gain, into the imprudence of entering upon a larger

farm than his property will enable him to manage with the spirit necessary to ensure success.

Much larger capital than was formerly requisite has become indispensable since the general adoption of the alternate system of husbandry; for the foundation of that system, and of all good farming, is the support of more live-stock than was possible when the land was brought round to the reproduction of corn by means of repeated fallows, instead of green crops. The charges, being then confined to those incidental to mere tillage, were comparatively light; whereas, now, there are arable farms without an acre of pasture, except perhaps a paddock for the cows, on which live-stock is kept to an amount far beyond the sum required for cultivation. But the produce is proportionally large; and more corn and meat are obtained from inferior soils in Norfolk, and other counties where the same plan is pursued, than from some of the best land in the kingdom under less spirited management. It is quite manifest that the more cattle and sheep are well maintained upon any given space of ground, the better will it be manured; and therefore, of two farmers, each possessing the same quantity of land, and devoting the same portion of it to grain, he who can support the most live-stock will not only realize the customary profit on that stock, but will also grow the most corn.

Except in situations where extraneous manure can be procured, it is only by the union of feeding with tillage, that land can be retained in a high degree of fertility. Were the system, therefore, more generally adopted—especially on all poor soils—of laying down a considerable part to grass, there can be no doubt that, if again broken up, its productive powers would be found improved through the meliorating effects of pasturage and rest; and while the gross produce would be thereby ultimately increased, it would so far diminish the expenses of labour, as in many cases to counterbalance the cost of the stock. The farmer who has the means, as well as the discernment, to make some of the various branches of grazing, or the dairy, an essential part of his business, and thus nurses a portion of his land, preserves the tillage in constant heart with the additional manure; and although the gross amount of corn may be less than if more ground were under the plough, yet the acreable produce will certainly be greater, and the deficiency will be more than made up by the supply of cheese and butter, and of flesh. He also divides his risk; so that, in the event of an unfavourable harvest, the loss upon his crops will probably be reimbursed by the profit on his cattle. It is a common observation, that graziers and dairy-men are the most regular rent-payers; to which it may be added, that the bane of all necessitous farmers, and the ruin of land, are under-stocking and over cropping.

The *sum actually required to stock and carry on a farm* must be regulated by the various circumstances already mentioned as influencing the choice, as well as upon its size. Much also depends on the nature of the covenants under which an incoming tenant enters:—the proportion which he is to pay of the repairs of buildings; whether he is entitled to the straw, and the proportion of tillages and manures for which he has to pay, according to the custom of the country; and whether he is to take the dead-stock at a valuation, by which he will necessarily obtain it for much less than prime cost, although not perhaps below its real value. Each of these affects the amount in its respective degree; and if the land requires draining, liming, or the application of purchased manure, an addition must be made to the estimated extent of the intended

improvement. Nor should the calculation be confined to these particulars, and those of labour, seed, and contingent expenses until the crops come round. It is true that a quarter's credit is usually given on each half-year's rent, and that tradesmen's bills may stand over, if required, until the end of the year. But supposing the entry to be at Michaelmas, this brings the greater part of the whole year's payments to the Christmas twelvemonth, before which time corn or stock must be sold to provide cash to meet them, and that at a moment when, in consequence of the same necessity pressing upon many farmers, the prices are commonly lower than at any other. Not only does this general pressure force an unusual supply upon the markets, and thus of itself lower the value of produce, but the dealers, being aware of the distress which compels the farmers to sell at that season, hang back, and take advantage of it to depress the prices still further. It is needless to dwell upon the disadvantage of being forced to sell during a glut: the difference between that and being enabled to wait for a rising market, will often be as great as that between a good and a bad crop; and it can only be avoided by the possession of sufficient ready money to defray all outgoings until a favourable opportunity occurs. This, from a variety of causes, usually happens in spring; and therefore, in the case supposed, the capital should be calculated to cover a period extending to nearly eighteen months.

It is commonly supposed that strong land requires much larger capital than the lighter soils. Rich, feeding ground, that carries a heavy stock, doubtless demands a proportionate outlay, and the more cattle that are kept on any farm, the more money will it absorb; but, except in partial instances, the difference in the expenses of cultivation on soils of various quality is not so great as generally imagined. The multitude of circumstances to be considered—each in some degree varying upon every farm, and with every farmer—preclude the possibility of forming any calculation that would be precisely applicable to every case; but, presuming the *land to be of medium quality*, and under an ordinary course of cultivation, the live stock to be of a good description, and the implements new, the requisite amount cannot be computed at less than from 7*l.* to 10*l.* per acre*. Less might perhaps *do*, and in many cases is no doubt *made to do:* an active and intelligent man who watches opportunities for picking up bargains of stock and implements, who is in tolerable credit, and is ingenious in devising expedients to supply the want of cash, may contrive to get through where one of less acuteness would fail. Such examples are common; but they are not to be relied on. They do not, generally, afford the means of accomplishing the arrangements necessary to a spirited course of management; and, judging from the best sources of information, less than the above sums will not enable the farmer to pursue such a course of husbandry, on the generality of arable soils, as would entitle him to a full return for his exertions.

The intelligence on this subject detailed in the County Surveys, though no doubt accurate at the time it was obtained, cannot now be in every case relied upon, in consequence of the different prices which prevailed at the times when they were severally published. Yet, although their publication includes a period of more than twenty years, and extends so far back as

* In No. 18 of the Farmer's Series of Select Farms, Mr. Sellar states the capita required, in Sutherland, at about 4*l.* to 4*l.* 10*s.* per tillage acre: but that only includes the working stock; and it is to be observed, that in the course of cropping pursued on his farm, on which no doubt his calculation was founded, nearly one half of his tillage land is annually in grass.

1793, they contain but few instances in which the sum is stated lower, according to the present value of money, than we have mentioned. The answers to numerous late inquiries have been nearly to the same effect. One very experienced farmer says, that "in Staffordshire, a farm of 250 acres of a medium quality of land, bearing a proportion of good, fair, and inferior qualities, and one-fifth in permanent meadow and pasture, would require 2,500*l.* in an ordinary state at entering, and an additional capital in proportion to the estimated extent of any improvements to be effected in the way of road-making, fences, and underdraining*." In this representation many others accord; and the following account, dated in January 1832, will partly show the ground on which it is founded:

Estimated Expense for Stocking a Farm of 150 Acres, including the necessary outlay *for the first year;* calculating one-third of it in meadow and pasture, and the remainder equally portioned off for tillage in a four-course shift for *Turnips, Barley, Seeds, Wheat:*—

	£.	s.	d.	£.	s.	d.
4 Plough horses at 30*l.* each	120	0	0			
1 Hack ditto	30	0	0			
				150	0	0
Plough and cart harness complete	40	0	0			
Saddle and Bridle	5	0	0			
				40	0	0
3 Carts 18*l.* each	54	0	0			
2 Waggons 30*l.* each	60	0	0			
2 Ploughs (iron) with trees complete, 4*l.* 10*s.* each	9	0	0			
Harrows with trees	7	10	0			
1 Roller	12	0	0			
1 Light turnip roller	5	0	0			
1 Ditto drill	4	0	0			
Mould and paring ploughs	7	0	0			
Angle harrow	4	10	0			
Grapes, shovels, spades, forks, picks, &c. &c.	5	0	0			
Winnowing machine	12	12	0			
2 Wheelbarrows	4	0	0			
Barn implements, riddles, sieves, measures, weights, &c.	6	0	0			
50 Bags for grain, 3*s.* each	7	10	0			
				198	2	0
Cows, &c. Stock:						
10 Cows at 17*l.* each	170	0	0			
1 Bull 18*l.*	18	0	0			
50 Sheep at 40*s.* each	100	0	0			
1 Ram	5	0	0			
Pigs, breeding and store	10	0	0			
				303	0	0
Wages:						
2 Ploughmen, each 36*l.*	72	0	0			
1 Cowman, or jobbing man	30	0	0			
2 Labourers, 25*l.* each	50	0	0			
1 Boy	2	10	0			
2 Women's wages, at 8*l.* and 4*l.*	12	0	0			
				166	10	0
Seed, Grain, &c.						
60 Bushels of seed wheat, at 8*s.* each	24	0	0			
60 Ditto ditto barley, at 5*s.* each	15	0	0			
75lbs. Turnip seed, at 1*s.* per lb. 3*l.* 15*s.*; hoeing ditto twice over, at 7*s.* 6*d.* each, 9*l.* 2*s.* 6*d.*	12	17	6			
				51	17	6
Carried forward				£914	9	6

* Mr. William Lewis, of Trentham, land-steward to the Marquess of Stafford.

	£.	s.	d.	£.	s.	d.
Brought forward . .				914	9	6
REAPING AND MOWING:						
25 Acres of wheat, at 10s. . . .	12	10	0			
25 Ditto of barley, at 8s. . .	10	0	0			
Mowing and getting 30 acres of hay, at 20s. .	30	0	0			
				52	10	0
Keep of 5 horses, say 20*l.* each, including blacksmith's shoeing, farrying, first year .				100	0	0
Half a year's rent . . .	112	10	0			
Keep of farmer's family for one year .	100	0	0			
Poor Rates . . .	20	0	0			
Assessed taxes . . .	10	0	0			
				242	10	0
Manuring 25 acres for turnips, at 6*l.* per acre				150	0	0
				£1459	9	6

No estimate is here stated for household furniture, which may be rated from two to three hundred pounds; but the first half year's rent may, perhaps, be taken from the farm by thrashing out grain, and the dairy produce may be disposed off, say one ton and a half of cheese, at 60*l.* per ton; 90*l.* to meet the amount of furniture and other necessary payments.

Theoretic writers object to charges for furniture and family expenses, as not properly forming part of the capital required to carry on a farm; and were the calculation limited to an estimate on the profit or loss of cultivation, the objection would be just. But, in real practice, a farmer must both furnish his house, and support his family, as well as stock his land; and in whatever way the money is to be applied, he must have the requisite sum. The objection is in fact, therefore, a mere cavil at terms, and amounts to nothing more than a distinction without a difference. Nor will it escape observation that the foregoing account does not contain any charge for a valuation of tillages to the outgoing tenant on entry, which it will be seen, by reference to the following chapter on that subject, may amount to a serious sum. It must, however, be admitted, that it charges every article as new, and at the highest sum, on which a very considerable saving might probably be made, according to the following estimate, founded on the estate of Scoreby, a report of the farming of which has been lately published*, of the—

CAPITAL required to enter upon a farm of 200 acres of a varied soil, at a rent of 200*l.* per annum, in the following state and rotation of crops, in the East Riding of Yorkshire:—

The stronger soil.	20	Acres in permanent grass.
	20	summer fallow—to be limed.
	20	wheat, which the entering tenant will have to pay for.
	20	red clover ditto ditto.
	20	beans.
The more friable soil.	20	green fallow, for which some hand manure will be required.
	20	barley or oats, which the entering tenant will have to pay for.
	20	grass seeds, of mixed kinds for pasture ditto ditto.
	20	grass for pasture.
	20	oats.
Acre	200	

	£	s.	d.
6 Draught horses, at 18*l.* . . .	108	0	0
2 Young horses 15*l.* . . .	30	0	0
Carried forward	138	0	0

* Library of Useful Knowledge, Farmer's Series, No. 25.

		£	s.	d.
	Brought forward	138	0	0
2 Draught oxen	14*l.*	28	0	0
2 Steers, 2 years old	9*l.*	18	0	0
4 Cows	13*l.*	52	0	0
10 Scotch cattle	4*l.*	40	0	0
80 Sheep	at 30*s.*	120	0	0
10 Pigs		8	0	0
	Live stock	£405	0	0

	£	s.	d.
20 Acres of wheat, and 20 acres of barley, sown by last tenant	200	0	0
20 Acres of clover, and 20 acres mixed grass, do. do.	31	0	0
The manure made upon the farm, supposed to be left without purchase			
Payment to the late tenant	231	0	0
Implements, say 2 waggons, 3 carts, 5 ploughs, 5 harrows, winnowing machine, roller, sledges, &c. purchased at half cost, second hand	120	0	0
Half a year's rent, to be paid before a return can be obtained	100	0	0
Trading capital, for wages, taxes, manure, extra stock, &c.	344	0	0
	564	0	0

		£	s.	d.
Recapitulation—	Live stock	405	0	0
	Late tenant	231	0	0
	Sundries	564	0	0
	Capital required	1200	0	0

Annual Expenses.

	£	s.	d.
4 Men constantly employed at 12*s.* per week	124	16	0
2 Boys do. at 3*s.*, 2 women do. at 4*s.* 6*d.*	39	0	0
Extra labour in the harvest	20	0	0
Labour	183	16	0
80 chaldron of lime, at 10*s.* per chaldron	40	0	0
40 qrs. bone manure, or manure equivalent, for turnips	40	0	0
Manure	80	0	0
20 stone red clover, 13*l.*, 30 stone mixed grasses, 18*l.*	31	0	0
Ray grass or hay seeds, 4*l.*, seed corn for change, 30*l.*	34	0	0
Seedsman	65	0	0
Poors' rate at 2*s.* in the pound rent	20	0	0
Constable's assessment, for county rates, &c., at 9*d.* do.	7	10	0
Road assessment, in addition to statute work, at 1*s.* do.	10	0	0
Churchwarden's assessment, at 2*d.* do., supposed tithe free	1	13	4
Assessed taxes, 2*l.* 6*s.* 9*d.*, 12 windows, 2*l.* 4*s.* 9*d.*	4	11	6
Taxes	43	14	10
Carpenter's account, 12*l.*, blacksmith's, 15*l.*	27	0	0
Ironmonger's, 3*l.*, saddler, 3*l.*	6	0	0
Druggist's, 2*l.*, annual new implements, 5*l.*	7	0	0
Tradesmen's accounts	40	0	0

	£ s. d.
Rent	200 0 0
Various incidental expenses	37 9 2

Recapitulation.	£	s.	d.
Labour . .	183	16	0
Manure . .	80	0	0
Seedsman . .	65	0	0
Taxes . .	43	14	10
Tradesmen's accounts .	40	0	0
Rent . .	200	0	0
Incidental expenses .	37	9	2
Annual expenses	650	0	0

Neither furniture, nor housekeeping are brought into this account; the wages are supposed to be paid in money alone.

A writer in a late number of the Quarterly Journal of Agriculture *, the accuracy of whose statement there appears no reason to question, estimates the expense of stocking and carrying on a farm, in Scotland, of 500 imperial acres of good land, under a five course shift, of 100 acres in bare fallow, turnips, and potatoes,—100 under wheat and barley,—100 oats,—100 grass seeds, and 100 year old grass; the entry at Whitsuntide; at 3569*l.* 17*s.* 11*d.* thus :—

	£	s.	d.	£	s.	d.
Implements, all new	289	15	10			
Steam Engine†	170	0	0			
				459	15	10
Live Stock.						
14 draught horses, at 30*l.* each . .	420	0	0			
1 saddle horse	30	0	0			
				450	0	0
1 short-horned two-year old bull . .	15	0	0			
4 ditto cows, that have calved, at 12*l.* each .	48	0	0			
4 ditto two year old heifers, for cow stock next year, at 12*l.* each	48	0	0			
20 ditto two-year old steers, for grazing in the summer, and fattening off on turnips, at 10*l.* each	200	0	0			
20 ditto one-year old ditto, for wintering in the first year, at 5*l.* each	100	0	0			
20 ditto ditto, bought in the second summer, at 5*l.* each	100	0	0			
				511	0	0
4 Leicester Dinmont Tups, at 5*l.* each .	20	0	0			
100 ditto ewes and lambs, unclipped, at 40*s.* each	200	0	0			
100 ditto ewe hogs, at 30*s.* each . .	150	0	0			
100 ditto ewe and wedder lambs, at 10*s.* each .	50	0	0			
				420	0	0
Pigs and poultry				7	0	0
Carried forward . . .				1847	15	10

* No. 15, November 1831.

† This is a large sum; nor can we wholly agree with the writer, that landlords hould erect the machinery of thrashing mills; but they should compel incoming tenants to take them by valuation, if required, because they cannot be removed, like other implements, without considerable loss.

	£	s.	d.	£	s.	d.
Brought forward . . .				1847	15	10
Seeds.						
Oats, 100 acres, at 6 bushels per acre—55 qrs. 6 bush. at 25s., 71*l.* 14s. 9*d.*; 18 qrs. 6 bush. at 23s. 6*d.*, 22*l.* 0s. 7*d.* . .	93	15	4			
Barley, 50 acres, at 5 bushels per acre—32 qrs. 2 bush. at 31s. 7*d.* per qr.	50	18	6			
Wheat, 50 acres, at 4 bushels per acre—25 qrs. at 56s. 6*d.* per qr.	70	12	5			
Grass, 100 acres of white and red clover and rye grass	87	10	0			
Tares, 4 acres	6	8	0			
Pease, 4 acres	4	0	0			
Potatoes *, 5 acres	2	16	0			
Turnips, 40 acres	12	15	0			
				328	15	3
Manure.						
320 bushels of bone-dust, at 2s. 6*d.* per bushel .	40	0	0			
320 ditto, in the second summer . .	40	0	0			
				80	0	0
Stable Expenses.						
154 quarters of oats, at 23s. 6*d.* . . .	180	19	0			
5 months' summer keep . . .	81	18	2			
Saddler, blacksmith, wheel and plough wright	75	0	0			
				337	17	2
Labour.						
9 men regularly employed . . .	228	10	6			
9 women, 150 days each in the first summer, at 8*d.*	45	0	0			
Ditto, second summer	25	0	0			
2 domestic servants, 1½ years . . .	27	0	0			
Cutting 35 acres of hay, 1st season, at 2s. 6*d.* per acre	4	7	6			
Ditto, ditto, 2d season	4	7	6			
Corn harvest	100	0	0			
				434	5	6
Incidental Expenses				13	4	2
				3041	17	11
Rent, at 40s. per acre—one year paid . . .				1000	0	0
				4041	17	11
Deduct Returns for the following articles before payment of the 2d half-year's rent:—						
Profit on 20 head of fat cattle, at 5*l.* each .	100	0	0			
Wintering of 10 kyloes, taken in 24 weeks, at 2s. 6*d.* each per week	30	0	0			
Ditto of 120 hogs ditto on turnips, at 5s. per score per week	36	0	0			
80 dinmonts and gimmers sold at 25s. .	100	0	0			
20 draft ewes, sold at 30s. . . .	30	0	0			
Produce of wool	152	0	0			
Ditto of dairy and pigs beyond the consumption of the family	24	0	0			
				472	0	0
Balance				3569	17	11

From the supposed period of entry to the farm, there is a payment of half a year's more rent than would be required were it at Michaelmas, and the other current expenses are calculated for a year and a half; but there

* 2½ acres of these potatoes are for the use of the farm-servants, who find the seed at their own cost.

is no charge for straw or dung, nor any estimate of tillages, which form so important a feature in the entry upon farms in some parts of England; nor does the balance include the cost of furniture for the house, or of support for the family. The rent covers the assessments, which in Scotland, where the land is generally free of tithes and poor's rate, are only trifling; and it is justly observed by the writer of the article, that nearly the same amount of capital would be required on a farm of inferior soil, though the rent might not be so much by perhaps 250*l.* a year.

ON THE SUBJECT OF ANNUAL EXPENSES.

It will, indeed, be generally found, that indifferent arable land will cost as much in the working as that of better quality, and in some cases even more, with less product; unless indeed when the soil is so poor as to require a considerable period of rest under pasture, to restore it after a short run of corn crops. In this all published statements of authenticity agree, and many of them nearly accord with the following "*Comparative View of the chief Heads of Expense on three different Farms of* 150 *Acres each*," (see next page,) on which considerable pains have been bestowed by the intelligent surveyor of Bedfordshire *, whose calculations have been made upon nearly the same rates of labour, horse-keep, and seeds as those of the present day.

So great are the variations arising from circumstances of local and individual character, that information obtained from private persons, or calculations founded upon peculiar farms, would seldom be found applicable to any other than the exact instances to which they refer. The nature of the soil, the mode of cultivation, the difference of the prices of labour, seeds, and horse-keep in different years, all render accuracy impossible in estimates of that kind. But were it possible to draw them so correctly as to suit every soil and system, much must still depend not only upon the intelligence and the industry of the farmer, but upon the vigilance with which he watches every item of his expenditure. Country tradesmen and peasant labourers are no worse than other people of the same degree; but common honesty and strict integrity are widely different, and many a one who cautiously keeps within the bounds of the law will not hesitate to overreach an inexperienced or an inattentive person in a bargain. With all his apparent simplicity, the ploughman is seldom deficient in shrewdness enough to perceive where he may take advantage of his employer, and if not closely watched he will assuredly relax in his exertions.

Farming, like all other business, affords a fair living profit to those who manage their resources with strict economy, and who recollect that it is made up of savings as well as gains. It varies in so many different ways, and is chequered by so many unlooked-for incidents, that no year ever presents the same result as the last, and some may even produce a loss. It would therefore be fruitless to furnish the details of farm accounts; but it may be assumed that a man of due ability and prudence should, upon an average of years, and upon a fairly rented farm, make 15 *per cent. of his capital.* Ten per cent. is the more common calculation; but that is far less than the usual returns of all other business, on a moderate scale, in which the personal exertions of the party are given in without being specifically charged. It is indeed true, that the comforts enjoyed by the farmer without expense should be considered, and that he lives more cheaply than a tradesman; but his business cannot be so easily extended when successful, and it is one of never-ceasing anxiety.

* Batchelor's Bedfordsh., p. 126. See also Bailey and Culley's Survey of Northumberland, 3d Edit. chap. ix. sect. vi. p. 31.

A comparative View of the various Heads of Expenses on the Three principal Modes of Cropping.

Succession of Crops....	Fallow, ½ tares	Barley.	Red Clover.	Wheat.	Beans.		Average.	150 Acres.
	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.	l. s. d.
Rent, Tithe, Rates, and Taxes	1 5 4	1 5 4	1 5 4	1 5 4	1 5 4	—	1 5 4	190 0 0
Wear and Tear of Implements	0 4 6	0 2 3	0 0 9	0 2 4	0 2 4	—	0 2 5	18 2 6
Ditto of Hurdles	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	—	0 0 4	2 10 0
Expense of Horses..............	2 7 6	1 0 0	0 5 5	1 1 1	1 0 1	—	1 2 10	171 5 0
Ditto of Labour................	0 15 6	1 13 10	0 11 6	2 1 0	1 14 0	—	1 7 2	203 15 0
Depredations and Losses	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	—	0 0 6	3 15 0
Expense of Seed	0 6 0	0 17 3	0 8 0	1 1 11	1 0 2	—	0 14 8	110 0 0
Total Expense per Acre ...	4 19 8	4 19 6	2 11 10	5 12 6	5 2 9	—	4 13 3	699 7 6
Succession of Crops ...	Turnips.	Barley.	Seeds.	Seeds.	Wheat.	Pease.	Average.	150 Acres.
Rent, Tithe, Rates, and Taxes	1 5 4	1 5 4	1 5 4	1 5 4	1 5 4	1 5 4	1 5 4	190 0 0
Wear and Tear of Implements	0 5 0	0 2 0	0 0 9	0 0 4	0 2 3	0 2 0	0 2 1	15 12 6
Ditto of Hurdles	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	2 10 0
Expense of Horses	2 6 0	0 16 10	0 5 5	0 2 0	0 17 10	0 16 10	0 17 8	131 5 0
Ditto of Labour................	1 11 0	1 12 4	0 11 6	0 3 9	2 0 6	1 10 6	1 5 0	187 10 0
Depredations and Losses	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	3 15 0
Expense of Seed	0 2 4	0 17 3	0 15 2	—	1 6 3	1 0 2	0 13 5	101 5 0
Total Expense per Acre ...	5 10 2	4 14 7	2 19 0	1 12 3	5 13 0	4 15 8	4 4 3	631 17 6
Succession of Crops ...	Fallow.	Wheat.	Oats.	Fallow.	Barley.	Beans.	Average.	150 Acres.
Rent, Tithes, Rates, and Taxes....	0 19 2	0 19 2	0 19 2	0 19 2	0 19 2	0 19 2	0 19 2	143 15 0
Wear and Tear of Implements	0 4 3	0 2 3	0 2 3	0 4 3	0 2 3	0 2 3	0 2 11	21 17 6
Ditto of Hurdles	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	0 0 4	2 10 0
Expense of Horses..............	2 4 3	0 17 6	1 0 0	2 4 3	1 0 0	1 0 0	1 7 8	207 10 0
Ditto of Labour................	0 14 8	2 2 4	1 13 4	0 14 8	1 14 0	1 14 0	1 8 10	216 5 0
Depredations and Losses	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	0 0 6	3 15 0
Expense of Seed................	—	1 1 9	0 12 0	—	0 17 2	1 0 2	0 11 10	88 15 0
Total Expense per Acre ...	4 3 2	5 3 10	4 7 7	4 3 2	4 13 5	4 16 5	4 11 4	684 7 6

Horses, per Annum, 24*l.* 9*s.* 9*d.*—Men, per Annum, 29*l.* 19*s.* 6*d.*

CHAPTER II.

ENTRY AND VALUATION.

The *time and mode of entry to a farm* are of more importance than is generally supposed. In Scotland, where the principles of leasehold tenure are admitted to be well understood, the usual time of entry to the buildings, fallows, and permanent pasture, is at Whitsuntide, the arable land being held by the outgoing tenant until the removal, or the separation, of the crop *. The same period, or old May-day, is also very general throughout the north of England; but, in the south, Michaelmas is more common, or Candlemas and Lady-day on dairy and grazing land.

Where fallowing forms a part of the regular system, the first, or *Whitsuntide entry*, is perhaps the most convenient, for the success of the future crops will greatly depend on the manner in which that important operation is managed, and the offgoing tenant having no other interest in it than being merely paid for the dressings, it is in that case seldom performed with the scrupulous care which it requires. It is, therefore, material that the new tenant should be allowed to enter on this portion of the land sufficiently early for that purpose, and his being put in possession of it can be no inconvenience to the man who is about to quit; but if at the same time deprived of his pasture, it may compel him to dispose of his stock at an unfavourable moment.

On lighter soils, on which the facility of growing green crops precludes the necessity of regularly fallowing a certain portion of the ground, the *Michaelmas entry*, particularly if coupled with the privilege of entry to the turnip fallow in May, presents the advantage of a more complete separation of the interests of the outgoing and incoming tenants, who seldom bear each other much good-will, and where the plan, now very generally adopted in the south, of purchasing the crops by valuation can be effected, it is always to be preferred. In this case, sufficient time is usually allowed, on proper security, for the payment until the crops can be realised, but if no such agreement can be made, the barns are necessarily left in the possession of the old tenant until the following May.

The advantages of the *Candlemas and Lady-day entries* to all grass land are too obvious to require remark; but, on arable farms, the latter term is highly objectionable, inasmuch as it occurs in the very heart of the spring sowing.

Thus these several periods each possess peculiar advantages and disadvantages, on which, however, further observation would be useless, for a tenant can only rarely choose the time of entry, which is generally governed by the termination of the previous lease, or other tenure; of far more importance, too, are the stipulations under which he is to obtain possession.

DUNG AND STRAW.

In Scotland it is by no means uncommon that the dung and straw are held in what is called *steel-bow*, a term of which the derivation is uncertain,

* See Kennedy and Grainger: Practice of Tenantry, part II., p. 84.

where opposed by peculiar clauses in leases, may be considered applicable to the greater part of England.

The farm is tithe-free, and consists of

	A.	R.	P.	
Near Common Field	4	3	0	Fallow.
Middle, do.	5	2	10	Oat stubble seeds.
Far	4	2	12	Seeds, second year.
Near Bent	3	3	0	Clover-ley wheat.
Far, ditto	4	2	0	For Fallow.
Hollin Feld	4	3	0	Turnips.
Near Bush Field	5	1	10	Seeds, second year.
Far, ditto	6	2	8	Pasture.
Dike	4	3	10	Oats after wheat.
Acres	41	2	10	

Rent and Taxes, £57. 10s. = £1. 5s. 10d. per acre.

A. R. P.		£ s. d.	£ s. d.	£ s. d.
4 3 0	NEAR COMMON FIELD—Fallowed.			
	Four dressings, at 13s.	2 12 0		
	Rent and taxes	1 5 10		
		3 17 10	18 9 8	
	16 chaldrons lime at 13s. 6d.		10 16 0	
	Carriage, 12 miles, at 1s. per mile per chald.		9 12 0	
				38 17 8
5 2 10	MIDDLE COMMON FIELD—Seeds, half tillage.			
	2 dressings, at 13s.	1 6 0		
	½ rent and taxes	0 12 11		
		1 18 11	10 16 5	
	Half of 50 loads manure, at 11s.		13 15 0	
	16 quarters hay-seeds, at 8s.		6 8 0	
	20 lbs. white clover-seed, at 1s.		1 0 0	
	Sowing and harrowing		0 10 0	
				32 9 5
4 2 12	FAR COMMON FIELD—Grass-seeds mown. No valuation.			
3 3 0	NEAR BENT—Clover-ley, to sow with oats. Allowance for tillages, at 50s. per acre			9 7 6
4 2 0	FAR BENT—For fallow.			
4 3 0	HOLLIN FIELD—Turnips, ridded, pared, and burned.			
	Rent and taxes		6 2 8	
	Ridding, at 7l. per acre, and paring and burning, at 24s.		38 19 0	
	Ploughing and sowing turnips, at 16s.		3 16 0	
	Turnip seed, 9lbs., at 10d.		0 7 6	
	Hoeing, 15s. per acre		3 6 6	
	½ value of the crop, at 4l. per acre		9 10 0	
				62 1 8
5 1 10	NEAR BUSH—Grass-seeds mown.			
	46 loads rotten dung, at 11s.		25 6 0	
	15 chaldrons lime, half-tillage, at 1l. 5s. 6d.		9 11 3	
				34 17 3
6 2 8	FAR BUSH—Pasture. No valuation.			
4 3 10	DIKE FIELD—Oat Stubble after Wheat.			
	One half of ridding, at 8l. per acre		19 5 0	
	Draining, 45 roods, three feet deep, at 3s. 6d. per rood, done three years		5 10 3	
				24 15 3
				202 8 9

A.	R.	P.		£	s.	d.	£	s.	d.
			Brought forward				202	8	9
			CROPS.						
5	2	10	MIDDLE COMMON FIELD.—Oats.						
			33 quarters oats, at 21*s*.	34	13	0			
			8 tons straw, at 25*s*.	10	0	0			
				44	13	0			
			Deduct thrashing, &c at 2*s*. 3*d*. per quarter	3	14	3	40	18	9
							243	7	6
4	2	0	FAR BENT—Wheat Stubble.						
			90 bushels wheat, at 8*s*.	36	0	0			
			6 tons straw, at 21*s*.	6	6	0			
				42	6	0			
			Deduct thrashing, &c., at 17*s*.	2	12	6			
							39	13	6
4	3	10	DIKE FIELD—Oat Stubble.						
			25 quarters oats, at 21*s*. 4*d*.	26	13	4			
			6 tons straw, at 22*s*.	6	12	0			
				33	5	4			
			Deduct thrashing, &c., at 2*s*. 3*d*.	2	16	3			
							30	9	1
			SUNDRIES.						
			12 tons hay, at 3*l*. 10*s*.				42	0	0
			6 ditto clover, at 3*l*. 5*s*.				19	10	0
			Manure in the yards, 25 yards, at 4*s*. 6*d*.				6	6	0
			Ditto, 35 yards, at 4*s*.				7	0	0
			Ditto, 36 yards, at 3*s*.				5	8	0
			Ashes, two loads, 1*s*. 6*d*.				0	3	0
			Garden, 28 gooseberry and currant bushes, at 6*d*.				0	12	6
			Ditto, 4 loads manure, in ditto, half-tillage				1	0	0
			Stone trough, 110 gallons, at 5*d*.				2	5	10
			Ditto, 72 gallons, at 6*d*.				1	16	0
			Pump, 14 yards deep, at 12*s*. 6*d*.				8	15	0
			Ladder, 21 steps, at 7*d*.				0	12	0
			Ditto, 30 ditto, at 8*d*.				1	0	0
							409	18	8
			DILAPIDATIONS.						
			3 gates deficient, at 8*s*.	1	4	0			
			5 posts ditto, at 2*s*. 6*d*.	0	12	6			
			50 yards fencing	0	11	0			
							2	7	6
							£407	11	2*

Thus the appraisement of mere labour, with common manure and hay-seeds, amounts to 202*l*. 8*s*. 9*d*. on 28A. 3R. 30P., being all the tillages valued; or, deducting the costs of the seeds, to 6*l*. 14*s*. per acre, of poor land, growing only twenty bushels of wheat, and the whole arable crops on which were only valued at 111*l*. 1*s*. 4*d*.

Another similar valuation, in the same work, on a farm of 240 acres in the West Riding of Yorkshire, one-fourth in grass, amounts to 1006*l*. 9*s*. 5½*d*.

* Tables will be found in the Appendix for ascertaining the contents of dung-heaps, hay-stacks, &c.; and also the forms of leases and valuations.

CHAPTER III.

RENT—LEASES—TERM—COVENANTS.

(*See* Supplement, post., No. 2, p. 7.)

THERE can be no question that a man who is possessed of adequate capital can afford to pay a higher rent than one who is cramped; and this, more than any other reason, accounts for the numerous instances of tenants succeeding on farms, at an advanced rate, on which their predecessors, although equally industrious, had failed; an occurrence so frequent as to have given rise to a very common opinion among landlords, that 'high rents make good farmers.' There are, no doubt, some indolent men, who, sitting under an easy rent, are content to enjoy that advantage without seeking to improve it by better husbandry; but the generality do not require any other spur to their industry than the natural desire of every one to better his condition, and provide for his family, and some of the best farmers in the kingdom are also owners of the freehold. The idea gained strength from the eagerness displayed during the late war to get possession of land on almost any terms, as well as by the apparent ease with which exorbitant rents were paid, through the high price of produce, and the increased quantity obtained by the application of additional capital. But the stimulus of high prices no longer exists; a great portion of the capital formerly employed has been either sunk or withdrawn, and rent has again become an object of the first consideration with every man of prudence. Nothing can be more erroneous than the common notion that a few shillings more or less are of no importance in the rent of an acre of good land. It is, indeed, generally true, that a man had better give a proportionally high price for good land, than allow himself to be tempted by the illusive advantage of a comparatively low rent, to venture upon a poor soil; neither may it be always prudent to reject an otherwise desirable farm because the rent is something beyond the mark. But fortunes are not so rapidly made by farming; independence can only be reached by the slow progress of accumulation; and *the difference of only twenty guineas a-year in rent, if regularly laid out at interest, will amount, in the course of a twenty-one years' lease, to seven hundred and fifty pounds.*

The RENT to which the proprietor of the soil is fairly entitled for its use, has, in all ages, been the subject of inquiry. The earliest allusion to it is found in the Scriptures, where it is fixed at one-fifth of the harvest*; and, in ancient times, the payment in kind of a certain portion of the produce of the land, together with some specified services of the tenants, was general throughout the civilised world. As population and commerce advanced, this custom was gradually abandoned, in most parts of Europe, for that of payment in a fixed sum of money; but it is still retained in some countries, and has not yet been wholly abolished even in this, for although its remains are only partially found in the English counties, it yet exists in some parts of the Scottish highlands, and in Ireland the cottar's, and sometimes even the small farmer's or under-tenant's, rent is paid

* And it shall come to pass in the increase, that you shall give the fifth part unto Pharaoh, and four parts shall be your own, for seed of the field, and for your food, and for them of your households, and for food of your little ones.'—*Genesis*, ch. xlvii. v. 24.

in labour*. When a *money-rent* was first substituted in England, it seems to have been estimated at about one-third of the average value of the produce, and while tillage was confined to the production of grain, and grazing to the consumption of grass and hay, such calculations were easily made, and probably near enough to the truth to establish them as a principle; but, under a more improved system, embracing a greater variety of objects, and consequently affording room for a more unlimited employment of both skill and capital, they can neither be so accurately ascertained nor so generally applied. The equitable amount of rent, or that proportion of the produce of the soil to which the landlord is entitled, is, in fact, the surplus that would remain after the payment of all charges, including a fair return to the farmer for his time and industry, as well as for the risk and interest of his money. But since the great improvements which have been made in draining and irrigation, in the application of fossil manures, in live-stock, and in the extension of tillage to a daily increasing number of crops that have become almost indefinite, it is extremely difficult, if not impossible, to fix an arbitrary rate: rents vary in different districts, not only from difference of soil, but also from the condition and state of the roads; their distance from market, and according as the general system of management established there is more or less perfect. It is also clear that the landlord's share should only be calculated upon the surplus that might be supposed to remain in the common course of cultivation: he can have no right to the additional profit that may be gained through the greater exertion, or the superior intelligence and capital of any individual tenant; and the claim would defeat itself, for it would prevent their application to his land.

Rent is, therefore, a matter of mere private bargain, in which, although each party may endeavour to obtain the advantage, neither is very likely to gain it; for the value of the ground is usually pretty accurately ascertained by the experience and observation of the neighbourhood. The sudden rise which occurred during the late war only kept pace with the increase of taxation and the diminished value of the currency. It bore no greater proportion to the value of money than at any former period; nor did land afford a higher interest for the investment of capital than any other security of equal permanence. It has since fallen to the same level,

* Its effects in Scotland are thus described in 'Smith's Survey of Argyleshire':—'The rents in general, especially on the larger estates, are paid in money; but tenants on the lesser estates, and near their landlords, often pay some of the rent in kind, and are almost always subject to servitudes. Peats must be made and led, so must the hay; assistance must, perhaps, be given in seed-time and harvest. So many wedders, fowls, eggs, butter, and cheese, lint, wool, oats, meal; so much spinning from the wives, or perhaps so much yarn; and sometimes they must pay the weaver, and give it in sheets and blankets. In short, so many hundred things are required by the laird, and so many hundred things by the lady, that it is impossible to pay them.'—Chap. iv. Sect. 2.

An equally curious enumeration of the items of which rent was sometimes composed in the highlands may also be seen in Mr. Loch's account of the improvements on the Marquess of Stafford's estates in Sutherland, Appendix, No. 1. The right of *thirlage*, by which the tenant is bound to grind his corn at the barony mill, is also still very generally enforced in Scotland, notwithstanding an act for its commutation passed in the 38th Geo. III.

Similar instances of *duty-men* and *horses*, and other *dues*, are found in the Irish county surveys; and in all it is complained of as a practice equally injurious to landlord and tenant; for the work being reluctantly performed is ill done, and usually occurs at the most inconvenient time to the farmer, and the articles supplied are generally of the most indifferent quality. In England, *boon-days*, and other manorial rights and stipulations retained in many leases since the times of feudal servitude, are equally objectionable.—*See the Surveys of Meath*, p. 61; *Kilkenny*, p. 423; *Tyrone*, p. 173; *Cavan*, p. 59; *Yorkshire, N. R.* p. 61; *Cumberland*, p. 211.

and probably will always find it. That more gradual advance which took place during the last century is rather to be ascribed to the improvements in husbandry than to any extraordinary increase in the price of produce*; for the farmer being thereby enabled to draw a greater amount from the soil, a larger portion necessarily fell to the landlord. This is his legitimate advantage, whatever may be the price, and (putting aside singular instances of unusual profit) it is what he will ever obtain; for, in a densely-inhabited country like this, where population presses against subsistence, and where labour is consequently cheap, the rent of land must always bear a due proportion to the value of its products.

It has been objected to a fixed *money-rent*, that, when land is leased for a long term, the fluctuation in the prices of produce presents an insurmountable obstacle to any certain calculation of its average value during a future series of years; therefore, that all such estimates must, at some time, be contrary to the interest of one or other of the parties; and this, being incontrovertible, has, in many recent instances, led to an arrangement by which the rent is made to vary with the market price of grain, and is therefore, though still payable in money, termed a *corn-rent*. But this is only a specious remedy, founded on the supposition that prices will fluctuate, and the amount of produce remain stationary,—a principle which is inconsistent with fact; for experience has proved that (unless under political circumstances) the price is regulated by the quantity. Now, rent can only be paid out of the profits of cultivation; and it is demonstrable that, in a fluctuating market, a corn-rent will not represent those profits fairly. Thus: supposing one hundred acres of land to be taken at 24*s.* per acre, or 120*l.* per annum—wheat being at 60*s.* per quarter—and the rent to increase or diminish 2*s.* per acre for every 5*s.* increase or diminution of the price of wheat. Then, supposing the land to produce, in ordinary years, twenty-four bushels per acre—as the price must depend upon the quantity grown throughout the kingdom, and no single farm can be presumed to grow more, according to its natural fertility, than the average crop of the season—it follows that, if wheat rises to 65*s.*, the produce can only be estimated at twenty-two bushels, for which the farmer would receive a fraction less than he would have got for the previous twenty-four†; yet he would have to pay 130*l.* rent instead of 120*l.*, besides additional expense of labour, in consequence of the increased price of provisions. Take the opposite side: corn goes down to 55*s.*‡, but the produce will then be twenty-six bushels, for which the farmer receives exactly the same sum as in the last instance, but will only have to pay 110*l.* rent, with diminished cost of labour.

If the calculation be pursued, it will present proportionately similar

* The average prices of middling wheat and of British combing wool were as follows:—

Wheat, per Quarter.		Wool, per Tod.
For 25 years, ending in	1744, 30*s.* 4*d.*	From 1700 to 1775, 17*s.*
Do. do.	1769, 33*s.* 7*d.*	1775 — 1782, 14*s.* 4*d.*
Do. do.	1794, 44*s.* 11*d.*	1782 — 1800, 18*s.* 6*d.*
For 21 years, commencing and ending with the war, and during the suspension of cash payments by the Bank	1814, 88*s.* 7*d.*	1800 — 1814, 31*s.* 10½*d.*

(*Reports of the Select Committee of the House of Lords on the Wool Trade, in* 1828.)

† 24 bushels, at 60*s.* per quarter = 9*l.*
22 — 65*s.* — = 8*l.* 18*s.* 9*d.*

‡ 26 — 55*s.* = 8*l.* 18*s.* 9*d.*

results; and although the progressive ratio of produce would probably be different in practice, in some particular cases, it yet is the only ground upon which any general estimate can be framed. The one mode is, therefore, as speculative as the other, and in the course of a long lease there would probably be but little final difference in the effect of either; but the corn-rent exposes the tenant to pay the highest rent, when, from the deficiency of his crops, it may be least in his power, and, from its uncertainty, subjects him to be called upon for a sum upon which he may not have calculated. It has also the further disadvantage, that as, from various causes which influence the value of farm produce, the prices of grain and cattle are sometimes in opposite extremes—the one being high, and the other low—and, as rent is not paid with corn alone, this increases the disproportion already stated: so that, were wheat dear and cattle cheap, the farmer would be a serious loser, for he would have to pay a rent calculated on the former, while he would only receive the diminished value of the latter; and, in the opposite case, he would be an undue gainer. It is no doubt true, that the general state of the markets rather tends to equalize the value of farm produce, and that such instances only rarely occur; but they may then be ruinous. It is therefore customary in such agreements, for the security of both landlord and tenant, to fix a *maximum* or limit, beyond which the rent shall not be suffered to rise, and a *minimum*, below which it shall not be allowed to fall. This guards against the extremes; but the *medium*, which is in all cases the most desirable, will be as well attained by a fixed sum*.

In the outcry that has been raised about the dearness of corn, one of the loudest demands is, that landlords shall lower their rents. But were the farmer to hold his land rent free, he would not sell his produce one shilling below the market-price; and, whatever may be the terms on which he holds it, he cannot obtain one shilling more, for the price is always governed by the proportion of the supply to the demand. High rents are, in fact, only the consequence, not the cause, of high prices: rent of land, therefore, solely concerns the two contracting parties, landlord and tenant; and whether the proprietor chooses to farm it himself, or to let it upon lease, is of no kind of importance to the consumer. The only way in which he could be affected would be by the existence of such a monopoly as might enable the landowner and the farmer jointly to raise their profits beyond the rate commonly obtained by other capitalists and traders. That they do not possess any such monopoly is evident from the notorious facts, that

* Corn-rents are also sometimes calculated upon an average of prices during three or seven years: thus, assuming 100 acres of arable land to have been taken, in 1830, at an annual rent of 40 bushels of wheat, the value to be determined by a three years' average of the *Gazette* price on the 31st December of each year, the rent in that and the ensuing year, would be as follows:—

		s.	*l.*		*s.*	*d.*
Wheat, per Imp. quarter,	1828,	74	6			
	1829,	56	11	———	56	11
	1830,	67	1	———	67	1
		3)198	6	1831	60	6
		66	2		3)184	6
			×40		61	6
Rent in 1830 .	£132	6	8			×40
Do. in 1831	.	.		£123	0	0

This mode equalizes the rent more effectually than that of calculating it upon single years, but the aggregate amount during the course of a lease will be the same, with the exception of the difference which may be occasioned by the variation of prices in the years previous to its commencement. Either mode is equally applicable to either grain or to wool, and may include all the produce of a farm

land does not pay a higher interest for money than the public funds; as well as that, whatever advantages of personal gratification may be enjoyed by the farmer, the pecuniary return for his capital and labour is not so great as in most trades. That it is beyond the power of the landed interest to create it, through a command of the markets, must be manifest to every one who considers the impossibility of combination among so widely extended a community: the necessity which compels the farmer to dispose of his produce ensures the supply of the markets to the full extent of his means, while the competition among the sellers keeps the prices at the lowest rate of return for trading capital, and the legislature has guarded the public interest, in case of a deficient supply, by then permitting the importation of foreign corn; whether more effectual means could have been devised to attain that object, or whether political considerations may dictate the expediency of yielding a portion of our cultivation to foreign countries, is alien to our present purpose.

The rent which the tenant should pay, depending upon the various circumstances already mentioned, admits of no general rule that could be applicable to all cases: prudence, and the advice of experienced persons, will be his safest guides; and, in coming to a determination, he will not lose sight of the additional and most important considerations—*whether any portion of the land is commonable, and whether the tithes are taken in kind.* In the first case, the farmer is precluded from adopting the most advantageous rotation of crops, and much of the land thus held remains in as unprofitable a course of cultivation as at the Norman conquest. In the second, it is annually deprived of a considerable part of the straw and fodder, without which a sufficiency of manure cannot be made to maintain it in proper condition.

TERM.

The *term for which leases should be granted* consistently with the interest of both landlord and tenant is a point that has been long contested. Many proprietors refuse to let their land for any definite period beyond a year: yet there are numberless instances of large hereditary estates on which the same families have been continued, formerly as tenants at will, now as tenants from year to year *, during many successive generations, and the tenant's right of preference is looked upon as so secure, that capital is unhesitatingly invested in improvements, and the farms are admirably cultivated †. These, however, are rather to be considered as exceptions to a general rule, than as affording any substantial reason in support of the practice, and, even in such cases, it can hardly be doubted that higher rents would be obtained if leases were granted, for, notwithstanding the reliance of the tenant upon the honour and consideration of the landlord, the same confidence is seldom placed in any man's word as in a legally secured right; or, even supposing it to be unlimited, still it can only attach to the actual possessor, and the lessee is exposed to be left at the mercy of an heir, who may not fulfil his expectations. Men who are acquainted with the practice of husbandry, know that the chief profit derived from farming is obtained by the progressive improvement of the land, through the various operations of draining, irrigation, fossil manures, and regular rotations, all of which require a series of years to bring round a

* The distinction between tenancy from year to year and tenancy at will is, that in the former case the landlord and tenant are bound to give half a year's notice before either party can put an end to the tenancy; whereas a tenancy at will may be put an end to at any time without notice. The latter tenancy is seldom, if ever, created in modern times with reference to agricultural holdings.

† Surveys of Yorkshire, N. R., p. 56. E. R., p. 72. Dorsetshire, p. 109. Berkshire, p 112.

fair return for the outlay. The man who has a lease in his pocket engages in such improvements, because he has the moral certainty of reaping the benefit of his exertions during its continuance; but he who fears to hazard any expense that will not be repaid by the ensuing crop, necessarily confines his views to that object, and the difference of lease or no lease affects every operation on the farm. Independently of all calculation, long tenantry begets attachment to the land: few men occupy a place during twenty years without endeavouring to render it comfortable as a residence, and feeling a reluctance to quit: it is, therefore, generally found, that old tenants are more ready than others to pay an advanced rent*, and, being best acquainted with the land, they are the fittest to manage it to advantage. The great improvements which have rendered Norfolk famous for its husbandry, and have more than quadrupled the value of some of its estates, were effected by means of twenty-one years' leases, which became general on the first attempt to break up the heaths and warrens in the north-west part of the county, and have, more than any other cause, contributed to those great ameliorations by which its formerly barren wastes have been converted into a garden †; and Scotland is also chiefly indebted to the custom of granting leases, for the great advance of her agriculture during the last century‡.

Rent can only be estimated by produce, and land will seldom be highly cultivated by those who are not secure in its possession for such a time as will afford the probability of an adequate reward for their exertions The public is, therefore, deeply interested in the extension of leases; but, whatever may be the motives which govern their refusal, as every landlord is entitled to the common power of control over his own property, and as no one is compelled to accede to his terms, so no one has a right to quarrel with his resolve, however he may question its prudence or deplore its consequences. If he makes a pecuniary sacrifice, it is to be presumed that he obtains an equivalent in the gratification of feelings which he considers paramount; nor is the determination wholly swayed by caprice, or by the wish, to which it is usually attributed, of maintaining influence and authority over the tenantry; there are arguments in its favour, which it would be unfair to withhold, and which we shall therefore give in the words of one of its ablest advocates—an annotator on the survey of the North Riding of Yorkshire:—

'It is the popular fashion of the times, particularly in the southern parts of this island, to rail at tenantry at will [*meaning tenancy from year to year*], where that kind of tenure is unknown on a scale of any extent; to assert that a country so held must be devoid of improvement, the tenantry oppressed, and the land-owners deprived of that share of rent which they ought to receive were their lands let on, what they call, a more durable tenure: but one fact is worth more than volumes of reasoning and declamation: let us, therefore, see how the fact stands:—The permanency of tenure under lease is held to be one of the greatest inducements to cultivation; but with tenants at will, [*from year to year*] occupation is more durable than with the former. The occupations of the latter are rarely changed, except for faults where, under a long lease, there ought to be change for the good of the neighbourhood and public, and where, so far as leases prevent such changes, they are evils. Not an estate in this

* Arthur Young's Survey of Norfolk, p. 47. See also Kent's Survey, and Rigby's Holkham.

† In some instances, the difference of rent between a twenty-one years' lease and a tenancy from year to year (frequently, though improperly, called a tenancy at will), has been estimated as high as seven shillings in the pound in favour of the former.—*Oxfordshire Report*, p 63.

‡ General Report of Scotland, vol. i, part iii., p. 188.

district, or other neighbouring ones, can be pointed out where the same families have not remained for generations on it, perhaps for many generations, and to a length of time which the surveyor points out, in some instances, as being attended with inconvenience, as being of so permanent and certain a nature as to prevent exertion. Estates may be shown where not a family has been changed, or a new one introduced, in the memory of man; where the tenants have gradually risen from the smallest farms to the largest, and settled some of their children upon the smaller farms, to rise again in their turns; while the parent has acquired property, and placed others of his children in various professions superior to that in which he originally started himself. By long leases it is to be supposed fourteen years' leases are meant, a term which is looked upon as reasonable, and as long as the tenant should expect, or the landlord grant; but in most parts of England where such leases are common the greater part of the tenants are changed at the expiration of a lease, for no mutual tie, either of friendship, honour, or attachment existing between landlord and tenant, the former is bound only by interest to the latter, and the latter, presuming upon the certainty of his lease, gives, probably, some occasion of offence, which is not forgiven when it expires; whereas in this county, a tenant would sit down very uneasy under the apprehension of being removed at the end of fourteen years. Being well acquainted with some estates myself in this county, and having inquired into the practice of many others, I am satisfied that no such frequency of change takes place, on an average the tenants holding their farms for a much longer term. Another argument against this tenure is, that the tenantry must be uneasy under a liability to a continual raisement of their rents, and a too frequent practice of it; but this keeps pace with the change, and no greater excess of it prevails than of the former; a much longer term runs than fourteen years, on an average, between one raisement and another; an estate is seldom raised more than once in the lifetime of the owner, and many landlords make it a principle never to raise a tenant to whom they have let a farm; and some even make an agreement to the purpose as long as such tenant shall conduct himself as becomes a man and a farmer. I believe this tenure to be, in every instance, in favour of the tenant, both for permanency of occupation and moderation of rent, for though the landlords here get a handsome and sufficient rent, I believe something more would be extorted were land of equal quality in leasing districts; but where a tenure is somewhat favourable to either side, it ought to be so to that of the tenant. For this possible loss of rent (for I am not certain that there is any loss) the landlord has an ample return in the attachment and good offices of his neighbours: should there be no loss of rent, he is a great gainer indeed.

'But there is another and far more valuable character which this tenure possesses, which is entirely overlooked: its moral and political tendency is disregarded or unknown; the tendency it has to make good neighbours, and orderly, virtuous citizens. In no country does there subsist between landlord and tenant a more friendly intercourse, or more frequent exchange of good offices: the tenant will not conduct himself in an unbecoming manner, because the consequence would be the loss of a good farm and a good landlord; the landlord, for still stronger reasons, will not be guilty of vexation or oppression, because, his character being forfeited, he would be unable to procure other tenants than the outcasts from the estates of other people, to the certain ruin of his own.'

In opposition to the idea that tenancy from year to year (frequently though inaccurately confounded with tenancy at will) is unfavourable to agriculture, the writer alluded to instances the high state of cultivation of the

district under survey, where it generally prevails. He then attributes much of the eulogium so generally passed on leases to interested motives of stewards, to whom long terms and large occupations are the least troublesome, and he concludes by observing—' that where the gentry live generally on their property, tenantry at will [*meaning tenancy from year to year*] is by far the best tenure, keeping up a mutual dependence and intercourse between the higher and lower orders—between landlord and tenant; causing the former to be acquainted with the wants and circumstances of the latter, and to be ready to relieve them, and the latter to be influenced and directed by the counsels and advice of the former; bringing them, by a more intimate acquaintance, more to a level with each other; rendering both of them better men and better citizens.' *

Such is the reasoning of the opponents of leases, and the principle thus advocated is gaining ground,† although it is notorious that the estates which have been most improved have been let for long terms, and that to the encouragement thus afforded to the employment of capital, the prosperity of our agriculture is mainly to be attributed. It is indeed obvious that, except under peculiar circumstances, no prudent man will venture his money without security; and therefore improvements, the expense of which can only be reimbursed by time, cannot be expected without the guarantee of possession during a proportionate period. When a farm is already in a high state of cultivation—the drainage complete, and the soil not requiring to be limed, or when the landlord is at the cost of all the permanent improvements, only charging a moderate interest to the tenant on the sum laid out‡—then, indeed, a short term, or even a tenancy from year to year, may be admissible; for, such land being usually let at rack-rents, the landlord will rarely eject a careful tenant who is regular in his payments; and the latter, not being called upon to risk his capital in any way beyond the usual routine of his business, has no reason to dread a notice to quit. But when land is out of condition—exhausted by previous mismanagement, foul, or naturally wet, and requiring successive fallows and draining at the tenant's expense—then a lease commensurate with the time which may be supposed requisite to return the full outlay, together with ample interest, is only what is just, and mutually advantageous, for the landlord ultimately participates in the benefit derived from the farmer's exertions. No term should be less than sufficient to enable him to bring the land round under one complete rotation of crops; and three courses will seldom more than repay him for anything beyond the most parsimonious expenditure of common husbandry. The duration of the lease should therefore be regulated by the nature of the soil, as well as by its condition. A long lease is the surest stimulus to spirited farming; its expiration is too far distant for the tenant to contemplate the uncertainty of a renewal; he therefore strains every nerve to get the land into the highest possible tilth, in order as promptly, and as long as possible, to enjoy the advantages which he well knows can only be thus realized; whereas a keen man, as tenant from year to year, or perhaps under a seven years' agreement, drains or starves the land, either to get the utmost present profit from it, or with the double view of

* Note, signed W. S., appended to Tuke's Survey of the N. R. of Yorkshire, p. 56.

† The answers transmitted to queries on this subject, circulated by the Society for the Diffusion of Useful Knowledge, corroborate this assertion; but they also generally admit, that on those estates where a mutual confidence has been long established between the landlord and his tenants, there is little perceptible difference between the cultivation of farms under lease, and those held from year to year.

‡ For the beneficial results of this practice to both landlord and tenant, see Mr. Loch's Account of the Improvements on the Estates of the Marquess of Stafford.

obtaining a long term at a reduced rent, when he shall have thrown it out of heart.

It may seem hard that the rent of a farm should be raised at the expiration of a lease, on account of improvements made on it by the tenant, and it would be really so if he did not benefit by them himself. But he works upon the landlord's capital as well as upon his own; and as he puts the whole of the immediate gain into his own pocket, he has no more reason to grudge the ultimate advantage which they yield to him, than he would have to object to the profit made by the manufacturer on his wool, or by the miller on his wheat; yet nothing is more common than for farmers to withhold an outlay that would be extremely profitable at the moment, in the dread of its occasioning an increase of rent on the renewal of their term.

The landlord and the tenant have, in reality, only one common interest; but, from viewing it in opposite directions, they more frequently counteract than assist each other. The object of the one is to get the highest, and of the other to give the lowest rent: and both can only be attained by superior cultivation, for it is by that alone that the farmer can afford to pay a high rent, and at the same time to secure a large profit, which is equivalent to a low rent. It is, therefore, the interest of the former to grant such terms as will induce the latter to make those exertions by which they are both to be benefited; but a short-sighted landlord, eager to avail himself of the utmost supposed value of his property, will only consent to a brief term, in the expectation of obtaining an increase of rent on its conclusion; while the tenant, resolved to afford as little room as possible for the demand, withholds all the essential improvements on which it might be founded, though he at the same time diminishes his own profit, and thus both are equally losers. This is particularly observable in much of the land in mortmain—belonging to the church, to colleges, or corporate bodies—where the term is frequently dependent on the tenure of an incumbent, or for seven years, renewable on payment of a fine, which, being exacted in proportion to the state of the property, acts as a constant check upon its improvement*. In Ireland, especially, large tracts are thus held; and lands under 'bishop's leases' are, even there, distinguished by the inferiority of their cultivation. In that country, indeed, the practice of taking fines is not confined to the clergy. It is common among every class of landlords, who, in that case, let the land for one or more lives, not only at a rent far below its value, but without any restrictive clauses, or at least without any that are observed. The sum thus obtained is seldom proportionate to the rent that is abandoned; it exhausts the tenant's capital; by thus depriving him of the power of making effectual exertions, it renders him indolent and careless, and it exposes the land to all the consequences of improvident and beggarly mismanagement†. Coupled with the system of granting leases to the highest bidder, this custom has, more than any other cause, contributed to retard the progress of agriculture in the sister kingdom; but it is fortunately growing out of use, and instances of more enlightened views, accompanied, where they occur, with conspicuous advantage to the property, are becoming frequent‡. It still, however, partially exists in

* Surveys of Berkshire, p. 54. Oxfordshire, p. 40.

† A very objectionable practice is also mentioned in the Survey of the County of Cork, of agents taking fees from tenants on the grant or renewal of leases. 'Instances are told of tenants dispossessed, contrary to every principle of justice and humanity, in consequence of not coming up to the agent's price; and of others, who, rather than lose the farm, have sold their all to purchase his good will, and have become bankrupts in consequence of his extortion.'—*Addenda*, p. 78.

‡ See remarks to that effect on the Rockingham estate.—*Wicklow Survey*, p. 119.

some parts of Scotland, and of the remote counties in England, and wherever it prevails the same results are observable,* though instances are frequent in which the very same tenantry engage, on the expiration of those leases, in the most spirited improvements.† It was formerly general in this country, and is mentioned by many ancient writers, one of whom quaintly tells us that—'what stocke soever of monie the farmer gathereth and laieth up in all his yeares, it is often seene that the landlorde will take suche order with him for the same, when he renueth his lease, that it shall never trouble him more than the haire of his beard, when the barber hath washed and shaven it from his chin.'‡

COVENANTS.

The *Covenants respecting Cropping*, in many leases, particularly on some large and ancient family estates, are founded upon obsolete and unprofitable systems of husbandry, equally inconsistent with modern improvements, and with prudent discrimination of the character of the tenantry. The same clauses are frequently introduced for different soils, under one common form adopted for the whole property, and are often of such a nature as to defeat the good management which it is their intention to secure. Thus in some, in which fallows are stipulated, dibbled beans are considered as crop, whatever may be the state of the land; and even turnips have been viewed in the same light, though in a district where they are usually drilled and horse-hoed.§ Flax, hemp, rape, mustard, and various other crops, are commonly forbidden, either because they are thought exhausting, though they cannot be grown to advantage without a plentiful supply of manure, which will restore the exhaustion of any crop, or because their straw or haulm is not convertible into manure, though the same objection lies against other articles not prohibited, and the land is not found to be impoverished where they are permitted.‖ We have lately seen one of a farm within carriage distance of London in which potatoes, although on a very light soil, are not allowed either previous to or after corn; and there are instances in which the quantity is, in all cases, limited to the amount required for the use of the farmer's family.¶ The sale of hay, also, and other indispensable articles of farm produce required for the consumption of towns, is frequently prohibited on farms in their vicinity, although the richest manure can be obtained there in return. Others direct the periodical application of lime, or marl, by the indiscriminate use of which it is well known that much valuable land has been seriously injured;** and others, again, stipulate for a clean summer fallow every third year.††

* Husbandry of Scotland, vol. ii. p. 216; South Wales Report, vol. i. p. 171, and vol. ii., p. 172; Plymley's Survey of Shropshire, p. 136; Farey's Derbyshire, vol. ii, p. 35; Survey of Cornwall, p. 19.

† Loch's Improvements on the English Estates of the Marquess of Stafford, p. 176.

‡ Harrison, Descrypcyon of Englande, b. xi. ch. 12.

§ Surveys of Lancashire (Dickson and Stevenson's,) p. 137; Yorkshire, N. R., p. 7..

‖ Ibid. of Northumberland, 3rd edit. p. 32; Dorsetshire (Stevenson's), p. 110; Somersetshire, 3rd edit. p. 270; Cambridgeshire (Gooch's), p. 39.

¶ Ibid. of Cheshire (Holland's) p. 109; Yorkshire, N. R., p. 71.

** Ibid. of Yorkshire, E. R., p. 75; Cumberland, 3rd edit., p. 211. Malcolm's Survey, vol. i. p. 95.

†† Grey's System of Farming under some existing Leases in Hertfordshire, 3rd edit., p. 10.

Mr. Boys, the experienced surveyor of Kent, says, that, even in that highly cultivated county, many of the leases are mere copies of old ones that have been handed down through several generations Some families are bound to sow wheat after beans, on land not fit to produce beans; to leave a quantity of podware gratten (a local term for stubble), for a wheat-tilth on farms where some sorts of podware are the worst tilth

This generally arises from a want of agricultural knowledge in the proprietor or his agent, who, not being qualified to decide on the proper mode of cultivation, find it convenient to adhere to old-established customs and one uniform plan, by which means a bad system may be not unjustly said to be perpetuated by indenture. Any honest man may be the receiver of an estate, and any good professional man may draw the leases, after the proper covenants have been agreed to, but the clauses should always be adapted to the peculiar state of each separate farm, and much more should be left to the discretion of a respectable tenant than is permitted by the jealous and injudicious caution of most leases. That restrictions are necessary, no one who understands the subject in all its bearings, and who is acquainted with the meaning attached to the common expression—"getting the land in readiness for the landlord"—can deny; but it must also be admitted that they should be appropriate to the soil, and that, as remarked by an eminent author,* while the tenant should be prevented from doing mischief, he yet should not be so fettered as to bar improvement. Leases should rather contain *that which a tenant shall not do*, than prescribe what he should perform.†

In no art are the prejudices of habit so strongly riveted, or so difficult to surmount, as in that of agriculture; and although it may not be expedient to oppose them too suddenly, or practicable to eradicate them otherwise than by the progressive effect of experience, it is yet in the power of every landlord so far to restrain them as to prohibit the continuance of customs that are elsewhere exploded, and radically bad. In nothing is this more apparent than in the rotation of crops. It influences all the operations of the farm; if good, it will ensure a profitable return to the

known to sow wheat upon; and on dry upland farms, where turnips and clover are known improvements, there is not the least mention of these articles.—*Kent Survey*, 2nd edit. 1813, p. 47.

* Lord Kaimes: Gentleman Farmer, p. 412.

† The following clauses in the leases of the Holkham property in Norfolk, have met with much approbation, and, with some modification, might be advantageously adopted for the regulation of most light soils.

Supposing the farm to contain 540 acres of arable land, the tenant is bound to keep at all times, and to leave at the expiration of the lease, 90 acres laid to grass of one or more years laying, and 90 acres of two or more years laying; each to be laid down with a crop of corn, after turnips, and to continue laid two years at least; the time of laying to be computed from the harvest next after sowing the said seeds; and, upon breaking up the same, is permitted to sow 45 acres (part thereof annually), with peas, or tares, for seed, to be twice well hoed: the other part thereof with tares for green food, or with buck-wheat, or any other leguminous or vegetable plant, for ploughing-in as manure, or summer-tilling any portion.

Not to sow any of the lands with two successive crops of corn, grain, pulse, or rape, or turnips for seed, (except the before-mentioned pea and tare-stubble), without the consent of the landlord being first obtained in writing.

Lands for turnips four clean earths at least.

The turnips covenanted to be left in the last year (90 acres), to be mucked, so far as the manure upon the farm will extend, and to be paid for by valuation, due regard being had to the cleanness of the land on which they grow.

Sheep, cattle, and all other live-stock to be lodged upon some part of the premises when consuming the produce of the farm.

Straw, chaff, and colder to be left without allowance.

Incoming tenant to carry out the crop of corn not exceeding the distance of ten miles, gratis.—*Norfolk Survey*, p. 50.

farmer, and the gradual amelioration of the soil; if bad, it cannot fail to have a contrary effect; and, next to the want of sufficient capital, it is the root of all bad farming. It is impossible to read the surveys of the United Kingdom without being struck with that fact, nor without astonishment at the apathy with which it is permitted by landlords, whose education and means of observation leave them less excuse than can be pleaded for an ignorant tenantry. To an enlightened farmer, who is known to practise the approved modes of modern husbandry, the management of the land may generally be entrusted with safety during the greater part of the currency of his term, for his own interest will probably teach him not to misuse it during that period, and precautions are only necessary towards its close; but, in most cases, the security of the landlord, and even the real interest of the tenant, require that the general mode of cropping should be so far regulated as the variableness of seasons will admit. To this it has been objected, that all restrictions cramp the enterprise of intelligent farmers, and impede the progress of agriculture; but that observation can only apply to the injudicious clauses with which some leases are still encumbered; and, if we reflect on the numberless objectionable practices which still prevail in many large districts, it will hardly be doubted that a very different result would be produced by leases drawn with judgment and due consideration. This, however, demands no ordinary degree of knowledge, and can only be accomplished by men who are conversant with the details, as well as the principles of husbandry.

As the subject of rotations will be separately discussed in a future portion of this work, it is only here necessary to observe, that, in order to frame a lease with due attention to the interest of both parties, regard should be had to all the peculiarities of soil; to the condition of the land, buildings, fences, and the various attendant particulars which it is impossible to enumerate. These being once ascertained, nothing can be more easy than for a steward and a tenant—both masters of their business—to agree upon the rotation of crops and other conditions, with such modifications as circumstances may require; allowing, whenever the character of the lessee may render such indulgence prudent, considerable latitude in the rotation during the greater part of the term, and only stipulating its close observance during the last four years, which is the only portion of the time in which injury to the property may be generally apprehended, and previous to the expiration of which the tenant should be put out of suspense in regard to the conditions of renewal. With that precaution, the covenants should be as few and as simple as possible, consistently with the landlord's security. To restrictions, thus settled, no reasonable tenant could object; and were such a conciliatory plan always pursued, and confided to persons of judgment, it is inconceivable how much many estates might yet be improved in value, both to the owners, the occupiers, and the public. Room should be left for fair experiment, and every prudent encouragement be afforded to enterprise; but great caution should be exercised in granting permission to break up any pasture without the strictest covenants for an equal quantity to be laid down, under inspection of the steward, with an assortment of seeds appropriate to the soil; and perhaps in no case should it be allowed, unless the sward be worn out, or moss-bound, and otherwise irreclaimable.

It is a principle advocated by all theoretic writers on agriculture, and to a great extent adopted by the Scottish low-country farmers, that no land, which is capable of cultivation, should be allowed to remain in *permanent pasture:* the former arguing, that as tillage employs more hands, and

incoming tenant being, in that case, obliged to thrash and carry out the grain as far as ten miles of the nearest market without charge.

12. To support a certain number of sheep during the currency of the term, and, where folding is practised, to pen the entire flock upon the land in the usual manner during the last year of the tenancy; or, upon strong grazing land, when the tenant retains possession until the spring, he is usually restrained from pasturing more than the customary number of cattle after the previous Michaelmas.

In order to secure the performance of some of the covenants—as those regarding the preservation of meadow, and the expenditure of fodder—certain penalties are stipulated; and for the infringement of those to which specific penalties are not attached, the tenant is exposed to an action for damages in proportion to the injury sustained by the landlord and to forfeiture of his lease: thus, even when the course of cropping is not specified, it has been repeatedly decided, that he is bound to farm the land according to the customary usages of good husbandry.

With regard to the *payment of rent*, the lessor has his remedy, if the tenant be in default, by distress upon the property on the premises, in this country and in Ireland; * and in order to guard against a fraudulent removal of the crops, a clause is sometimes inserted rendering the rent due at Michaelmas payable forty days previous, on notice to that effect being given in writing, though it is only generally intended to be enforced in the last year of the term, when the lease expires at that period. In Scotland, where the civil, or old Roman, law prevails, the landlord enjoys what is there termed 'the right of hypothec,' under which he has a preferable charge or lien upon the crops until payment of the year in which they were produced, and upon the stock until three months after the expiration of the last term of payment, before all other claimants, except the farm-servants for their wages,† and sales of the farm produce, or stock, are not valid until he is paid. *See* Supplementary Note, No. 2.

CHAPTER IV.

TITHES AND PAROCHIAL ASSESSMENTS.

THE next material consideration, after rent, is the assessments, of which the most important is TITHE. Few farmers are so ignorant as not to be sensible that, were tithes simply abolished, rents would be proportionately increased, and that it can make no difference to them, in point of amount of disbursement, whether they pay the landlord or the parson. But this reasoning applies only to tithe for which a commutation is taken in money, and which, in that case, may be viewed as rent; for, wherever it is collected in kind, it operates to the direct injury of both landlord and tenant, to an extent beyond its mere pecuniary value, by depriving the land of one-tenth of its natural manure: thus deteriorating the property of the one, and impeding the labours of the other. It may be true, that no injury is thus done to the community, as the manure, though taken from one piece of ground, must be applied to

* The mode of executing a distress for rent, together with the heads of the other laws and usages relating to landlord and tenant, will be stated in an appendix to this work.

† The preferable right of the farm-servants for their current wages was finally established, after a long contest, by a decision of the Circuit Court of Justiciary, in the case of Glashan *v.* the Duke of Athol, 1818.

another; but this is no answer to the individual sufferer; and, independently of the real loss sustained through the abstraction of the produce, its collection is attended with so much inconvenience, and often occasions so much bickering and ill-will, that the inducements should be very strong to tempt any man to enter upon a farm from which tithe is collected in kind. Even where not thus collected, it is, in many places, customary to value each crop upon the ground, and to rate the tithe accordingly; a plan which, though not so objectionable as the former, is yet attended with considerable trouble, and occasions innumerable disputes.

In some parishes, the land is tithe-free; or the tithe is regulated, according to ancient custom, either in a particular manner, or at a certain rate, called a *modus**, either upon the crop†, or by the acre; and, in the latter case, differs in no respect from a fixed rent. In others, it is estimated by agreement with the parishioners, either collectively or separately, at a given sum per acre: in some, it is collected with moderation ‡, and in others with all the severity allowed by the law. Much of it is in the hands of laymen, who, either finding the advantage of enriching their own land at the expense of their neighbour's, take it in kind; or, not being resident in the country, let it to persons who make its collection a business; and it is but justice to the clergy to admit that, with few exceptions, they are much more lenient in its exaction than lay impropriators. In whatever manner it be levied, it is incumbent on every one holding land that is subject to tithe, to acquaint himself with the strict rules by which it may be demanded; of which, when not otherwise regulated by custom, the following is a brief outline.

THERE ARE THREE CLASSES OF TITHE—personal, prædial, and mixed; the first of which being nearly obsolete, the two latter alone affect the farmer. The *prædial-tithe*, so called from *prædium*, an estate in land, arises from every product of the earth, whether grain, pulse, hay, plants, fruit, or wood, and becomes due whenever the crop is taken, even although there may be more than one grown upon the same land within the year §. *Mixed-tithe* is leviable, with some exceptions, upon all animals, and their produce, supported or reared upon the land; as the young of cattle, sheep, pigs, and poultry, with the milk, wool, and eggs. These are all reduced under the two general heads of small, and great or *Rectorial and Vicarial Tithe*, which are sometimes consolidated and sometimes separated, and are payable accordingly, in some cases to the rector, and in others to the vicar, or to both; land being, in many instances, free of the one, though subject to the other. The rector is entitled by the common law; the vicar only by endowment or prescription: but the question of their separate rights is one in which the farmer is not personally interested.

Great Tithe comprises corn, pulse, hay, and faggot-wood: the principle on which it is founded being, that it includes all articles of produce that are susceptible of being bound together; and, therefore, in the canon, or ecclesias-

* From *modus decimandi*, the mode of tithing.

† The tithe of hemp, flax, and madder, is fixed, by particular statutes, at five shillings per acre, throughout the kingdom.

‡ A most judicious practice is mentioned in the Kent Report of a great tithe-collector, who, in order to encourage the chalking of land, remitted to farmers the tithe on the following crop. 2d edit., p. 159.

§ Thus clover and other artificial grasses, and meadow hay, pay tithe on each cutting, if there be no prescription to the contrary. (*Burn's Ecclesiast. Law*, vol. iii. p. 377. *Toller on Tithes*, p. 62.) Sir Samuel Toller says, upon the authority of a case reported in Gwillim, that turnips sown as an after-crop, or what are usually termed 'brush turnips,' upon land on which corn has been previously grown and paid tithe, are exempt; but he afterwards cites other cases, in which such turnips were held liable to agistment tithe. See Agistment, p. 74. 3d edit., pp. 68, 86.

tical law, it is termed *decimæ garbarum*, the tenths of the sheaves, although they may not be removed in that manner from the land. Thus, it has been decided, that podded pease, though gathered green, and the stem left standing, are subject to great tithe, because they might be reaped, and bound with the baulm*. For the same reason, grass eaten by the cattle on the ground, without being mown, and therefore not susceptible of being bound, is free of rectorial tithe; and upon a similar, though not equally clear principle, the seeds of grasses, as clover, tares, and sainfoin, or rape, &c., are only subject to the vicarial tithe, because they are usually thrashed out upon the spot where they are cut.

Small Tithe extends to every titheable article not comprised in the great tithe, as grass, when uncut, seeds, roots, fruit, hops, domestic animals, wax, and honey: both being governed by the one common rule—that the tenth part of the produce of the soil, or of its value, is due to the tithe-holder, unless the land has been exonerated from tithe, or that a modus, or real composition in lieu of it, has been established by ancient usage. When tithes belong to laymen, they are saleable in perpetuity, and many persons have been enabled to render their estates tithe-free, by their purchase; but, when the property of the church, they are unalienable; and a composition made with a clergyman is not binding on his successor, unless confirmed by the patron and ordinary, and then only for twenty-one years.

By the statutes for dissolving religious-houses, 27 and 32 Henry VIII., c. 7, s. 8, tithes have acquired the nature of temporal inheritances, and may be sued for in the temporal courts; and by statute 2 and 3 Edward VI., c. 13, they are required to be set out previously to the removal of the crop, under penalty of three times their value. The tithe-owner has a right, both personally and through his tithing-man, to inspect the stock and crops at reasonable times, in order to ascertain their amount; and it is customary, in most parishes, to give him notice of the time when the crop is to be reaped. When that custom has not been established by immemorial practice, it is not, however, required by the law†, though good sense dictates its propriety, and good temper, by which so much is often gained and nothing ever lost, marks it as a courtesy that ought not to be omitted.

In setting out tithe,

It is the duty of the occupier to leave every tenth corn-sheaf, or grass-cock, from the first commencement of the cutting, and it is customary to distinguish each by sticking a green twig in it. It is, of course, to be clearly understood, that all the sheaves, or cocks, must be as nearly as possible of the same size, for were those left for the tithe-owner less than the others, it would be a fraud for which he would have his remedy at law: but he has no right to alter the arrangement made by the farmer, and must take those which are set out for him.

Whatever the farmer does for his own benefit, in securing the crop upon the ground, he must also do for that of the tithe-owner, so far as that the latter may be enabled to collect his share; but he is not answerable for the consequences of bad farming, nor obliged to do more than what the common customs of husbandry require. Thus, in an action for damages against the parson for not taking away the tithe of turnips after notice given, and every tenth turnip being drawn and thrown upon a separate

* Simms *v.* Bennet. Gwillim's Cases in the Exchequer, vol. iii. p. 874, and the decree affirmed in the House of Lords, 7th December, 1762. But field pease, gathered for consumption in the farmer's family, have been held to be free of tithe; although the same exemption has not been extended to other vegetables used for culinary purposes.—*Toller*, 3d edit., p. 120.

† Ibid. p. 67.

ridge for his use, and he having refused to remove them, because they were not gathered into heaps, the court decreed 'that a man is not compellable to bestow more labour than the nature of the thing required, for the benefit of the parson*.' He must, however, do all that is necessary; and, although in the case of turnips, which are generally consumed by cattle upon the ground, the mere drawing them might be deemed sufficient, yet in other instances it would not; for the crops must not only be taken from the ground, but set out also, in such manner as that they may be divided and removed with the least difficulty: thus, potatoes, hops †, and seeds must be measured; corn and pulse must be set up in the usual sheaves, or, if carried loose, must be separated into shocks of equal size; and hay, of both natural and artificial grass, must be gathered into grass-cocks in the customary mode. On the latter point disputes have frequently arisen; some farmers contending that, as they are not bound to make the grass into perfect hay for the parson ‡, and as clover, for instance, is rarely tedded, it should be sufficient to leave every tenth swathe for the tithe; but the point was decided in the manner already stated, in a trial before Lord Ellenborough, in 1808, when that learned judge delivered as his opinion—'*that the time of tithing was that first stage of the process when the subject-matter might be most equally divided; and that is, when the grass is put into cocks in the common process of husbandry* §:' and, in all cases, the general rule is—'*that each article is to be tithed when it comes into such a state of severance (separation from the lands) that the parson may see whether he has his full tenth* ‖.' To this it may be added, that the tithe-owner must be allowed to complete the making of the hay upon the ground, and to remove all tithe at reasonable times. Should he not do so at the time the farmer carries his crop, the tithe cocks or sheaves should be left standing in the field, and notice be given to take them away; which, if neglected, authorizes the farmer to remove them at the owner's expense, if they are worth the cost, and if not, and that their being left upon the land impedes its cultivation, or the pasturage—for he must not turn in his cattle while the tithe is upon the ground—he would be justified in destroying them. The more regular mode, indeed, is to bring an action for damages; but this is a vexatious, an expensive, and an uncertain remedy, and the better way is to remove the nuisance, even at the risk of an action by the tithe-owner ¶; care being, however, taken to have clear evidence of the facts, as well as of the value and charges of the tithe, and, above all, to do nothing intemperate.

VALUATION.

In valuing crops upon the ground for tithe, the expenses of carrying, stacking, and threshing, or otherwise rendering them marketable (but not those of reaping, mowing, digging or picking, and measuring), are to be deducted from the estimate; and, on corn, it is customary to consider the straw as a fair equivalent; the tithe being, in that case, calculated upon the value

* The point arose, but was not decided, in Brooke *v.* Power: Wood's Exch. Tithe Cases, vol. iv., 96.

† Hops are not, however, required to be kiln-dried; but must be measured when taken from the bine.

‡ In some parishes, however, a contrary custom has been established; but, in such cases, it is usual to deliver only the eleventh or the twelfth shock, instead of the tenth, as an equivalent for the additional trouble.

§ Newman *v.* Morgan. K. B. Trin. T. 48 Geo. III. 10 East, 5.

‖ Judgment of the court in the case of Collins *v.* Howes. Exch. Trin. T., 37 Geo. III.

¶ Sir S. Toller says, the farmer may *distrain* the tithe for the damage occasioned by its not being taken away. *Toller on Tithes*, third edit., ch. iv. pp. 71, 72.

of the grain alone. Some close calculators, however, have judged two-thirds of the straw of wheat to be a sufficient allowance; and one reverend gentleman, distinguished by the acuteness of his researches into the rights of tithe-holders, seems to think that a claim might even be successfully made upon the value of the stubble, if the crop should not be cut close to the ground. But it is evident that such a demand could not be supported, for the farmer might leave the whole crop to perish if he pleased, and in that case could not be called on to pay any tithe; the principle of which extends no farther than to compel the husbandman to account for the tenth part of that by which he has himself profited.

When crops are sold standing, before severance, the purchaser is liable for the tithe; but if cut, although sold while they remain upon the ground, the seller continues answerable.

Tithe was not formerly considered due upon *rakings*, provided they be not fraudulently left in the process of harvesting: but it has been recently decided, in an action for the recovery of *the tithe upon three bushels of barley*, raked and carried to the mow, that when the quantity is considerable, although involuntarily left in the common process of husbandry, tithe is payable †.

AGISTMENT.

When crops are eaten by cattle upon the ground, the tithe is termed *Agistment*, and is estimated according to the value which they are supposed to have consumed; but, in the case of stubbles, or of aftergrass on meadows that have been already mown, it has been held that it is not due, the expense of cutting the previous crop being deemed a fair discharge from the demand, although it does not exonerate aftermath from great tithe, when cut the second time ‡. Were grass, however, to be cut unusually early, for the express purpose of securing an abundant after-pasture at the expense of the hay, there is little doubt that the courts would decide a claim for agistment in favour of the tithe-holder; and it is payable on clover and similar crops, when first fed, and afterwards allowed to stand for seed.

Agistment-tithe is due—with the exceptions hereafter named—for all cattle depastured within the parish §, which do not contribute to the tithe-holder in kind, in which case they are technically called '*unprofitable*;' but such as produce young, or wool, or milk, being titheable upon that produce, and consequently '*profitable stock*,' are exempt. It is collected per head, and is calculated from the time when they are severally turned upon the land until they are taken off; but is not demandable unless they are sold or removed out of the parish.

The principle of this, as well as of other tithe, entitling the owner to a full tenth of the produce of the soil, or its value in money, agistment is commonly rated at one-tenth of the rack-rent: but when stranger stock

* Glanvill *v.* Stacey; 6 Barnewall and Cresswell, 543 K. B. 1827.

† The contrary has been strongly contended for in a treatise on agistment-tithe by the Rev. Thomas Bateman, and would even seem to be supported by a decree in his own case (Bateman *v.* Aistrup and others, E. T. 14 Geo. III.) in the Exchequer in 1774: but the question has been again brought before that court in subsequent trials, and decided as stated in the text. See *Toller upon Tithes*, 3rd edit. 1828, p. 64. Indeed, most of the old authorities concur in supporting the exemption of after-pasture from tithe (see *Rolle's Abridg.*, v. i. p. 640; and *Sir S. Degge*, p. 2, c. iii.); and although a contrary opinion has been held by Dr. Burn, yet his authority is doubted in a note by the editor of the sixth edition of his treatise on the ecclesiastical law, who refers to various cases in which it has been otherwise determined. V. iii. p. 477.

‡ By stat. 2 and 3 Edw. VI. c. xiii. s. iii., cattle pastured upon wastes not included within any parish still pay tithe in the parish in which their owner resides.

are taken in, the tenth of what they pay is due *; or it may be estimated at the price usually charged in the neighbourhood for pasturing similar cattle, which necessarily varies according to the quality of the feed; and thus the value of turnips, when fed on the ground, is calculated by the number of animals fed. But when crops are carried off the land, for the purpose of soiling, it is usual to value them per acre; and, where tithe is taken in kind, the tenth of each cutting or drawing must be delivered, unless it be for the use of excepted stock †. It follows, therefore, that all stall-fed or soiled, and straw-yard cattle are free of agistment, because tithe is paid upon the produce on which they are fed when taken from the field. Nor is tithe recoverable upon their increased value, but merely upon the food which they consume ‡; and thus, a colt, which, though grazed at an expense of 5*l*. a year, might be improved to the value of fifty, pays only on the former sum.

The other exceptions are—all working cattle, when not kept for hire, or habitually employed out of the parish; riding horses; cows, if maintained solely for the supply of the farmer's family; sheep and oxen slaughtered for their use; and young stock reared for the plough or pail. But should any of these be removed out of the parish, they then become liable for their grazing from the period of their discontinuance from working or milking, or for the time they were pastured as young stock, after severance from the dam. The law of agistment-tithe may therefore be comprised within the following rules:—

1. That all cattle, as above excepted, are wholly exempt.
2. That no cattle whatever are liable for their pasturage on aftermath or stubbles, nor when stall-fed or soiled.
3. That cattle becoming profitable to the tithe-owner by the production of young, or by being milked, or shorn, or worked in the parish, are thereby discharged from all previous dues §.
4. That the tithe on unprofitable stock, or on stock which has ceased to be

* Except on commonable land, on which the tithe of agistment is due by the occupier of the soil, whether owner of the cattle or not.

† It is stated, in a treatise already mentioned, by the Rev. Mr. Bearblock, that, a question having arisen whether tares cut green for the use of working cattle were subject to tithe, it was submitted to an eminent counsel much consulted on parochial matters (the late Mr. Samuel Marryat), who gave it as his opinion 'that the tithe-owner was not entitled if the tares were cut green, and, *for want of sufficient fodder*, given to agricultural cattle only. But that the farmer is not at liberty to sell his hay, which (although after paying tithe upon the hay-crop) has been carried to the rick-yard, and, by thus diminishing the *regular provender*, to avoid payment of the tithe which the tithe-owner would become entitled to if the tares were consumed upon the farm.' But the reverend author forgot to add, in that edition of his work published in 1818, that the question had been twice tried and most fully reported, in 1817, in the court of Exchequer—the second time upon a motion for a new trial,—*and was each time decided against the tithe-owner*, notwithstanding the court concurred in Mr. Marryat's opinion. Stevens *v*. Aldridge, Exch.: 5 Price, p. 334. *Toller on Tithes*, chap. iv. p. 83.

It is the more necessary to notice this, because Mr. Bearblock's publication is quoted as authority by all collectors of tithe; and, as farmers are seldom without hay of some kind, a decision in conformity with his view would be contrary to the principle of the exception from agistment in favour of working stock, the motive for which is, that they contribute to the production of crops which pay tithe; and as, at the early period when tithes were established, and in those southern countries where they were instituted, cattle were seldom housed, it is probable that the exception was meant as a discharge from all dues to the church upon their food.

‡ Judgment of Chief Baron Parker in the case of Willis against Harvey, Exch Mich. T. 1768.

§ It must be, of course, understood, that this latter exemption can only be claimed *bonâ fide*; that is to say, that were steers or heifers reared for the yoke or the dairy, with the intention of selling them when fit for use, instead of employing them on the

	£.	s.	d.	£.	s.	d.	£.	s.	d.
Brought forward .	15	15	0				3	0	0
28th July 1 for	5	5	0						
1st to 8th Aug., 4 for . . .	22	7	0						
				43	12	0			
Less extra expenses on suckling, at 10s. each				4	0	0			
							39	12	0
Value of milk to other extra calves bought for suckling, from the above dates to 29th Sept. . . .							20	0	0
Total value							62	12	0
Tithe							6	5	0¼

The *suckling of calves* for veal being a practice introduced by modern luxury, is not noticed among the ancient regulations of tithe; but, as the young animals would suffer if deprived of the tenth day's milk, it is only reasonable that the suckler should be allowed to pay upon the value of the calves, after deducting the cost and extra expenses of those purchased. It is, however, doubtful whether, in strictness of law, payment might not be enforced in milk; but it is usual, in dairy counties, to pay a yearly sum for each cow beyond the number kept solely for the use of the family.

The manner in which the tithing of milk, wool, and some other articles of common produce, is regulated, is as follows; always, however, subject to be varied by any local custom which has existed time immemorial.

The tithe of *milk* is payable, when no prescription exists to the contrary, by every tenth meal, both morning and evening, and not by every tenth quart. It is generally supposed that the milk should be carried to the vicarage, or to the church porch, and there, should the tithing-man not be ready to receive it, that it may be spilled upon the ground; and much difference of opinion appears to have formerly prevailed on this point among the judges of the superior courts; but, according to a late authority, it seems to be now finally decided, "that, if there is no particular custom, the parishioner is only obliged to milk the cows at his usual residence or place of milking, and to keep it until the next milking-time, previous to which the tithe-owner must take it away in his own vessels *."

Tithe is not due upon *butter*, nor, generally, upon *cheese;* but there is a custom in some parishes, where cheese is constantly made, to pay the tenth part at the end of the season, instead of the milk, the whey, which is not titheable, being deemed equal to the expense of churning.

The tithe of *wool* may be rendered by the tenth fleece; but the most common and the most regular way is by weight †. The locks and clippings are exempt ‡.

The tithe of *pigs* being either taken in kind or estimated on the value of each litter, or paid annually, in a fixed sum for each breeding sow, those afterwards fatted are exempt; but if only the number of seven have been farrowed, and no composition having been paid, then one pig is payable to the tithe-owner; or, if a less number than seven be farrowed, they are wholly exempt.

That of *poultry* may be levied either upon the chickens or the eggs, (or

* Toller, 3d. edit. p. 128 to 135.

† Formerly the tithe of lambs and of wool was apportioned, according to the time the sheep were fed, among the claimants in the different parishes, when they were fed in more than one: but it is now payable in that parish in which they yean or are shorn; and thus they may become liable to both tithe in kind and of agistment, if fed in different parishes.—*Burn's Eccles. Law,* vol. iii., p. 472.

‡ Toller, 3d edit., p. 136.

a modus either for each, or the whole quantity in some places customary,) but not on both. Decoys of wild ducks, and pheasants or partridges, though kept tame, are exempt.

The tithe of *honey* is taken by liquid measure, but that of the *wax* by weight.

WOOD.

Wood, of more than twenty years standing, if oak, ash, elm, or of any other kind, which by the custom of the country is deemed '*gros bois*, gross wood,' or timber, is exonerated from tithe by the statute entitled *de Sylvâ cæduâ*, 45 Edward III., c. 3; but if, when cut down, the stumps be left as stools, the shoots pay as coppice*; and birch, willow, maple, alder, hazel, holly, and those species which cannot be considered as timber, are subject at whatever age they may be cut †. In like manner all loppings of pollards, although the tree be of more than twenty years' growth, and the trimmings of hedge-rows cut as faggots, or brush-wood, and even acorns and beech-mast if sold, are subject to tithe; and it has been decided, that, in setting out the tithe of wood, or acorns, (unless the latter be left for consumption on the ground, in which case it is exempt,) it must be either stacked, or bound into faggots, or measured, in the manner in which it is commonly prepared for removal.

From this tithe, however, there are exemptions, by the statute 2 Edward VI., c. 13, in favour of the bark, and of all woods used as fuel in the owner's or tenant's dwelling, or for the repairs of the premises, the making of agricultural implements, fences and hurdles, or other purposes of husbandry, provided it be so applied in the same parish in which it is cut; but *hop-poles* are only exempt when the tithe of the hops and wood belongs to the same person; and, as the one is rectorial, and the other vicarial, and may be held separately, the exemption cannot, in that case, be claimed. Yet, notwithstanding these specific provisions of an act of parliament which is still in force, a decision was lately obtained in the Exchequer in favour of a claim to the tithe of wood, which was proved to have been used for the above purposes, on the ground, ' that it is titheable as soon as it is felled; and that the subsequent use which might be made of it, could not be ascertained for some months afterwards ‡.' This reasoning is, however, far from conclusive, and the declaration of the intended use should be held sufficient to exonerate it until it be removed out of the parish, in which case the owner would become liable.

Some districts, chiefly the site of ancient royal forests, are also wholly free of this tithe, and this local immunity extends to all the lands within the precincts of that extensive range known as the Wealds of Kent, Surrey, and Sussex.

Orchards and *gardens* are titheable not only on the fruit that is gathered, and on the windfalls, but also on the grass if mown, or fed; or any other crop produced upon the ground: but the grass of lawns, mown solely to keep the sward in order, and that on the headlands in arable fields, is exempt. Tithe is also due on plants sold out of a nursery; even, it has

* It was decided in the Court of Exchequer, in the case of Evans v. Rowe, in July, 1825, M'Cleland and Younge, 577, that oak growing from stools, *though eighty years of age*, was titheable, no proof being given at what age the tree was originally felled, though it was admitted that it must have been exempt, if sprung from an acorn. The decision was, however, dissented from by Baron Graham, and appears so inconsistent with the provisions of the statute of Sylvâ cæduâ, that it would probably be reversed if carried before a higher tribunal. See the *Property Lawyer*, vol. v.

† Maiden trees, of beech, have, however, been held to be timber. *Ibid.*

‡ Willis v. Stone, Exch. 1827. Younge and Jervis, p. 262. Prop. Lawyer, vol. iv. p. 122.

been lately held, if transplanted within the same parish: but when the tithe of fruit has been paid, the trees which produce it, if afterwards cut down, are exempt.

The parson is not entitled to notice on the pulling or cutting of fruit or vegetables in gardens; but the tenth part of what is used must be left for him.

WASTES.

Respecting *waste land*, it is enacted by 2 Edward VI., c. 13, 'That all such barren heath or waste ground, which before that time had lain barren, and paid no tithe by reason of the same barrenness, and now or henceforth shall be improved and converted into arable ground, or meadows, shall from henceforth, *after the end and term of seven years after such improvement fully ended and determined*, pay tithe for the corn and hay growing upon the same.' The law was wisely framed for the encouragement of inclosures, but in its enforcement the courts have thrown so much doubt upon its provisions, or have construed them, in most instances, with such an evident leaning to the church, as nearly to deprive it of force. There arose, however, a most important discussion on this subject, on the enclosure, a few years ago, of the parish of Broadfield, in Cumberland; and after a long-contested suit, it was decided by three different juries, that 'where the first crop shall be inadequate to the payment of the whole cost of cultivation, lime, &c., tithes are not payable for the succeeding seven years *.'

RENT OF TITHES.

In valuing the rent of land subject to tithes, their amount, as well as that of all other assessments, must be deducted; but the proportion which they bear to each other, varying according to the liability of the soil to tithe upon its produce, or to other assessments upon its value, no certain rule can be laid down for such calculations. The following estimates, taken from a recent and very useful publication †, will, however, afford some idea of the manner in which they may be framed.

On arable farms of which one-third is kept in grass, and on which all tithes are due, one-fifth part of the annual value, or rack rent, is, in general, deemed a fair compensation; that is, land which, if free of tithe, would be worth 35*s*. per acre, is only considered worth 28*s*. per acre if subject to the payment of both great and small tithe. Thus, were it required to ascertain the value of the *full tithe* upon a farm of one hundred acres, supposing it to be under the following course of cultivation—

20	Acres of wheat, presumed worth	£160		
10	,, barley	70		
5	,, oats	25		
5	,, beans	25		
10	,, clover	35		
10	,, turnips	35		
10	,, fallow	—		
30	,, hay and agistment	75		
			£.	s.
	Tithe, one-tenth	425 =	42	10
	Expenses of collection		7	10
	Net tithe		£35	

this sum would average 7*s*. per acre, or one-fifth of the rent. But were the farm subject only to *corn-tithes*, the account would stand thus:—

* See Mr. Curwen's Report to the Workington Agricultural Society, 1819.

† Bayldon on the Valuation of Property for the Poor-rate, p. 174.

20 acres of wheat, presumed worth			£160
10 ,, barley			70
5 ,, oats			25
5 ,, beans			25
	Tithe, one-tenth	280=28	
	Expenses of collection	4	
	Net tithe=4s. 9½d. per acre=£24		

According to the foregoing estimates, the value of the vicarial appears to be about one-half of the rectorial tithe, which agrees with the common valuation on such farms as that here supposed: so that, in calculating the rates payable in respect of rent and tithes, the following would be their relative proportions:—

	ent per acre, if tithe free	35s.
Value of	full tithe 7s. / great do. 4s. 8d. / small do. 2s. 4d. — per ac^e.	
Rent	if titheable in full	28s.
	if only subject to great tithe	30s. 4d.
	if only subject to small tithe	32s. 8d.

RIGHT TO TITHE.

In Catholic countries, tithes are possessed solely by the church, and are there claimed *jure divino*, by divine right. Here, however, they are held only by the common and statute law; and, although the title to their possession rests upon a foundation as strong as to any other kind of property, yet, the legislature, having the power to limit the exercise of all rights which become injurious to more extensive interests, has on various occasions interfered in their regulation.

In Scotland, so early as 1587, the whole of the *teinds*, as the tithes are there called, with the exception of those granted as endowments to colleges and schools, were annexed to the crown; and were commuted in the reign of Charles I. into a fixed modus, estimated at one-fifth of the annual value of the land, out of which a stipend is paid to the minister of each parish. This is generally allotted in certain measures of grain, which continue to bear some proportion to the changes in the expense of living, and it is in the power of the court of teinds, within whose jurisdiction this portion of church property lies, to augment the parochial provision whenever it may become insufficient. The act of commutation empowers the owners of all estates to have their tithes valued at any time, after which the rate then settled is unalterable; and it also allows them to purchase that valuation at a fixed price, unless the tithes should be collegiate property, which, though subject to valuation, is not saleable. Of this permission most of the proprietors have availed themselves, and although some have neglected it, and there are consequently still instances in that country of land remaining subject to tithe in kind, yet the value is almost invariably included in the rent; and to use the words of an eminent Scotch surveyor, "the farmer has there no concurrence with the clergyman of his parish, but to live with him in good neighbourhood, and to profit by his instructions and example *."

In Ireland, the pasture-land, though forming the largest portion of the island, was discharged from the tithe of agistment by an act of parliament, and other regulations of a more comprehensive nature have been since enacted, and are in further contemplation.

In this country, perhaps the interest of the church itself, but certainly

* Agricultural Survey of Berwicksh. by Robert Kerr, F.R. and A.S., 2d. Ed. p. 126.

that of agriculture, and of the country at large, with which it is so intimately interwoven, calls loudly for a law to regulate the assessment of tithe in proportion to the rent, or annual value, instead of the product of the land. Not only does it, in many instances, present an insuperable bar to the cultivation of wastes, but it also greatly impedes the improvement of better soils, from the reluctance which men feel to employ their capital upon an object, the profit of which must be shared with another, who contributes nothing to the risk. It has been justly observed, that if ten pounds in value of produce can be raised from an acre of land, by the expenditure of nine, it is manifestly desirable that it should be produced, since, exclusive of the maintenance of those engaged in its cultivation, it would add one pound to the national wealth; but, while titheable, such land must continue unproductive, for no one will undertake to cultivate it while the tithe-owner is to reap the whole benefit. Indeed, so general a feeling to that effect seems to have been awakened by late discussions on the subject, that it is probable some legislative measure will ere long be adopted towards a general commutation. *See* Supplement, No. 3.

PARISH RATES.

The other *parochial assessments* which peculiarly affect farmers are those of *highway duty and poor-rate.*

The acts which regulate the former, or what is usually called *statute labour*, direct that all persons keeping a waggon, cart, or tumbril, and three or more beasts of draught, and occupying lands within the parish to the yearly value of 50*l.*, shall—during six days in each year, and at such time and place as the surveyor of the roads shall appoint, by four days previous notice—send one such cart, furnished after the custom of the country, with three oxen or horses, and all necessary tools, together with two able-bodied men, *for every* 50*l. in yearly value so occupied*, to assist in repairing the roads within the parish.

Persons keeping such a team, but whose lands do not exceed the yearly value of 30*l.*, are only required to send one labourer; and those who do not keep a team, but who occupy land, are subject to a composition-rate of sixpence in the pound on their yearly rent.

In case an entire team should not be required, a cart and two horses, with one man, are deemed equal to two-thirds of the service; and if only one horse, to one-half. Three men may be demanded in lieu of a team; and the penalties for neglect are ten shillings for a full team, and smaller sums, in proportion, for the others. It is, however, in the power of any one exposed to this rate to compound for it in money, either by a sum fixed by the justices of the district at the Michaelmas quarter-sessions—and which sum must not exceed twelve shillings for a full team—or, if no such rate be fixed, then by payment of the following sums:—

For each cart with	3 horses and	2 men,	8*s.*	per day.
	2 do.	1 do.	4*s.*	
	1 do.	1 do.	3*s.*	

The inhabitants of every parish have also the right of naming three separate months in the spring and summer of every year—termed the *seed-month, and the hay and corn harvest months*—in which statute duty shall not be performed: and when the entire duty is not required, either a general abatement is made throughout the parish, or the names of those who are subject to the rate are drawn by lot, at a vestry meeting, until a sufficient number for the necessary service be obtained; in which case the names so drawn are omitted in the following year.

The farmer's teams are also subject to be impressed, by order of the justices, for the conveyance of troops. But this duty seldom occurs, and their line of march rarely extending beyond the great roads, it is not general, and it is paid for by the parish.

In England, the repair of any road can be procured by indicting the parish in which it is situated; but in Scotland no law exists by which repair can be enforced; provided the heritors of a parish can show that their statute labour has been expended. It is true that they may expend what they please by agreement among themselves; but the majority of the parishioners have no means of compelling the minority to agree to an assessment that had exceeded the fixed and legal bounds.

In Ireland the roads are generally of very superior quality, though without the aid, except in some particular spots, of any turnpike. They are formed by *presentment*, by the justices of peace at the quarter-sessions, declaring by petition, upon oath, the sum necessary for repairs; and though subject to the usual complaint of jobs, yet their admirable materials and the light wear occasioned by any heavier weight than a single-horse car, keeps them throughout the main roads in the very best state of repair.

POOR-RATE—*See* Supplement, No. 4.

The provision for the poor, which, under the title of *poor-rate*, presses with such unexampled severity upon the landed property of this country, arose out of the dissolution of the monasteries in the time of Henry VIII., when such numbers of aged and infirm persons, who were dependent upon the charity of those establishments, were deprived of support, that it became necessary to provide for them out of the public bounty. An act was accordingly passed in the forty-third year of Queen Elizabeth, 'for raising in each parish, either weekly or otherwise, by taxation of every inhabitant being an occupier of lands, houses, tithes, saleable underwoods *, or coal-mines, within the parish—competent sums of money for the purchase of a stock of flax, hemp, wool, &c., wherewith to set the poor to work; and also towards the necessary relief of those who, being lame, impotent, old, or blind, are unable to work; and for apprenticing their children.'

According to this statute, the chief enactments of which are still in force, the whole personal property of the parishioners is liable to be assessed to the rates; but, from the difficulties opposed to this mode, it is customary only to assess them according to the annual value of the houses and land in their occupation †. These are either rated according to their actual rent, or supposed value, which is usually calculated at about two-thirds of the real sum; it being evidently immaterial whether the rate be levied upon the

* By '*saleable underwoods*,' such coppice only is understood as is subject to tithe, and intended for sale, in contradistinction to such as are to supply the landlord with fuel, and for the other purposes of the estate. But notwithstanding the rate can only apply to woods cut under twenty years growth, and that it must be always uncertain whether they may not be allowed to stand beyond that period, it has yet been decided in a case of appeal, in the Court of King's Bench, (*Beaumont v. the Parish of Mirfield*, 10 East, 219) that it is leviable annually. This, however, can only be construed to apply to underwoods commonly thinned or cleared within the prescribed time; and, as an annual valuation of the progressive growth would be inconvenient, it is customary to take an average of the entire term; which, supposing the value to be 8*l*., at the end of twenty-one years, has been calculated, by Mr. Bayldon, as equivalent to an annual rent of 5*s*. per acre.—*Treatise on the Valuation of Property for the Poor-Rate*, p. 198.

† In assessing land, the value of buildings used merely for agricultural purposes, and for the farmer's dwelling, is not usually calculated separately, as they are necessary to the cultivation of the soil, and included in its valuation.

real amount, or only on a part, provided that, whatever may be the proportion of rating adopted, it be equally laid upon all persons. Should any one have reason to complain of being assessed either beyond the real amount of his rack-rent, or at a higher proportionate value than his neighbours, he has a right of appeal to the justices at the quarter-sessions: but the rate must be paid, if demanded, even pending the appeal; and, in cases of default, it is in the power of two justices of the district to summon the defaulter, and to issue a distress warrant against his goods, if he refuses to comply with their order of payment.

The original intention of the statute was only to provide a maintenance for those whose infirmities rendered them incapable of supporting themselves, and the means of employment to those who were without work. That it has been much abused, and that its extension to the indiscriminate relief of paupers in health has tended to lessen the sense of self-respect, and the honest pride of independence, and to lower the character of the peasantry of this country, there can be no doubt; while, at the same time, it has imposed a very grievous burden on the land. Much of this, however, has arisen from the annual appointment of overseers of the poor, rather according to rotation among the parishioners, than to their fitness for the office, whence the business is often conducted with negligence, and not unfrequently with ignorance; thus giving rise to mistakes in orders of removal, law charges of appeal, arrears of rates, and a variety of evils, injurious both to the poor and to the parish. Instead of this injudicious mode, some parishes have adopted the far preferable plan of appointing permanent overseers of competent ability, with a proportionate salary, to render the office worth their constant attention. These men being necessarily versed in the routine of the business, and acquainted with the real state of the poor, are better enabled than those of less experience, both to avoid mistakes, and to detect imposture. In large parishes where this has been done, pecuniary savings have arisen to a far greater amount than the expense incurred; and in small parishes, which do not afford constant employment for an overseer, one man might perform that duty for several places.

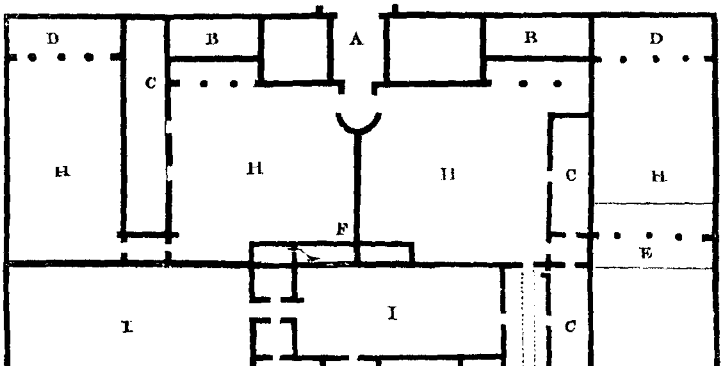
In Scotland, although the wants of the poor are by no means disregarded, yet the more wise application of the law—aided by the considerate custom, there generally adopted, of paying a large portion of the wages of agricultural labourers in fixed quantities of meal, and other articles of necessity, without reference to price—has confined their claim within limits which do not press inconveniently; and in Ireland, her swarming population, unaided by any compulsory law, has hitherto contrived to maintain itself independent of parish alms.

See Supplementary Note, No. 4.

CHAPTER V.

FARM BUILDINGS.

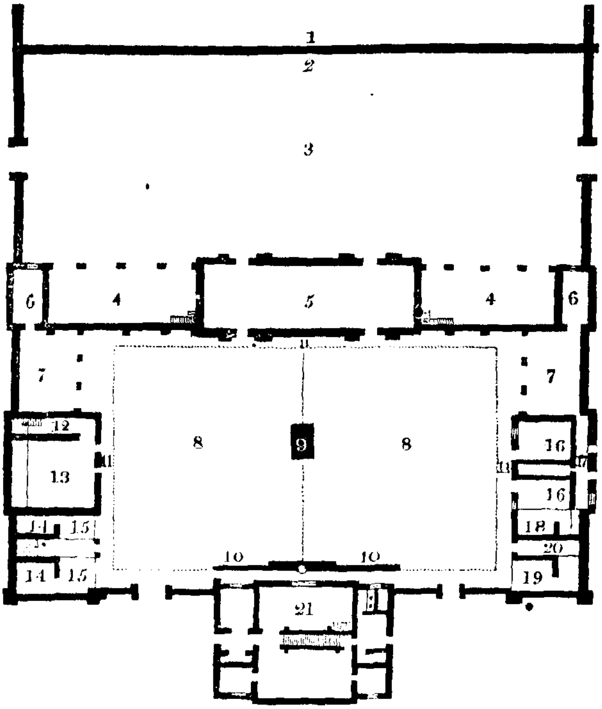
CONVENIENCE and simplicity should be more studied than symmetry in farm buildings. Neatness, compactness, and solidity, should be attended to ; but the main object is to have the house and offices so arranged as to save all the time and labour possible, and to enable the farmer to carry on his business with the fewest number of servants, by which the advantage of habits of order and industry, as well as the saving of expense, are acquired. The most approved mode, on the generality of farms, is to erect buildings on the east, west, and north sides of an oblong square, and to divide this into two fold-yards for cattle of different ages ; the south being, except the fence, left open to the sun, for the sake of warmth, with the house and smaller offices in front, in the manner recommended in Bailey and Culley's Survey of Northumberland*.



A, Being the barn, opening to the rick-yard.
B, Sheds, over which are granaries.
C, C, C, Stables, cow, and cattle, &c.
D, D, Sheds for young stock with stacks over.
E, Sheds for carts and implements, with stacks over.
F, Piggeries.
G, House and offices.
H, H, H, H, Sheds with fold-yards.
I, Garden and house-yards.

Or, according to a more extensive plan of offices belonging to a gentleman in the East Riding of Yorkshire, mentioned in the 4to. edition of the Survey, as follows :—

* 3d edit., 1813, Ch. iii. sect. i. p. 26.



1, Outer ox-houses.
2, Inner ditto, for hay.
3, Stack-yard.
4, Sheds for carts, granaries over each.
5, Barn, with two thrashing-floors: 72 ft. long by 23 ft. wide, and 20 ft. high.
6, Hen-houses, &c.
7, Open cattle-sheds.
8, Fold-yards.
9, Pump.
10, Covered troughs for pigs that run in the yard.
11, Causeway round the yard.
12, Harness-room.
13, Stable for 8 horses; lofts over.
14 and 15, Pigstyes and courts.
16, Cow-houses for 4 cows each: lofts over.
17, Fodder passage and turnip-house.
18, Calf-pens.
19, Poultry-yards.
20, Sheds.
21, House, dairy and offices.

But though this be the plan most generally approved, the site of buildings must, nevertheless, depend, in many instances, on other circumstances. The west wind, for instance, is often more to be guarded against than the east; and small farm-yards are not always susceptible of complete inclosure buildings, though they should always be surrounded by strong fences: the expense is not worth naming, for if nothing better can be procured, furze, or even stubble, will effectually secure cattle from cold. Too much cannot be insisted on this; for even admitting, as it is thought by many, that cattle are more healthy in open than covered yards, they yet should be secured from draughts of wind, which are more searching and cold than the open air without any shelter.

It is also generally advised, that the farm-house should be placed directly in front: to which, however, it may be objected, that it casts a shade over the southern entrance of the yard, if very near, and if too far off, its distance will be found inconvenient. Perhaps the best situation is on one side

of the farm-yard, with the common parlour and kitchen opening nearly into it: farmers may talk as they like about unhealthy odours arising from their stables and yards, but there never was any one injured by them, and they cannot keep too close an eye upon their servants and stock. It is also obvious that the size of the offices should be according to the extent of the farm to which they belong, as well as to that branch of husbandry which they chiefly occupy; that they should be distinct in their uses, and situated as nearly together as may be possible with any degree of convenience. But homesteads vary with farms, and it would be just as inconsistent to dictate the plan of a farm-yard as of a farm; one requiring arable and the other pasture land, and different sizes, soils, and situations, in every case. In most old homesteads no regular plan has been adopted; succeeding tenants having added what they thought most convenient, and new inclosures, as well as old farms, added together, have increased the general irregularity of farm erections. In this, perhaps, there is nothing more inconvenient, in very many situations, than the position of the buildings with regard to the land. There are many reasons which prevent their entire removal, even when ruinous, though that is a state they are seldom brought into, unless no longer employed; such as roads, gardens, orchards, and particularly the convenience of water. Ancient manor-houses, no longer occupied except as farm-houses, and mansions held with land in detached parcels, in villages, are thus situated, and afford but little remedy, though the waste, by loss of time, is a serious expense. We feel, therefore, that our efforts can be but inefficient in the recommendation of any regular disposition of the offices on most farms, and that all we can contend for is a decent and comfortable dwelling-house, a capacious barn, with dry stabling and sufficient sheds for cattle and implements, cow-houses and piggeries, and shelter of a minor sort. But although the disposition of these may be unavoidably inconvenient, they may be kept warm and clean, which are the greatest requisites to health and good order.

The materials are as various as the forms of which they are constructed. Quarries, which can be worked at moderate expense, command a preference, from the great durability with which they are attended; but nothing can be better or cheaper than the flint of the chalk counties. Flat tiles are also very much used in Sussex, and other exposed situations, for facing the houses, which they render very warm and comfortable, but brick or stone take the lead. Many old farm-houses consist, indeed, of nothing more than lath and plaster, or timber framed, and filled up with clay-walls covered with thatch, and inconveniently placed, with farm-offices of the same materials. They are, however, when kept with any tolerable degree of neatness in the covering, both warmer and cooler, in the different seasons, than other roofs, especially when the dwelling is small. They no doubt are more subject to vermin and to accident, and therefore are objectionable as dwelling-houses; but cattle-sheds *under single roofs* are preferable, for superior shelter, when thatched either with straw or heather. Much senseless outcry has been raised about the manure exhausted by straw in this way, though not a word is said of the far greater waste of straw for hampers and packing-cases. The buildings are subject, it is true, to a trifling sum for extra insurance from fire, but it can only be of small amount, and the protection of the cattle is of more importance. It is not our intention to offer directions for the construction of buildings, for every man who intends an alteration employs some regular workman, who is competent to perform it. We therefore consider their plan and arrangement as more important, and in that view shall confine ourselves to only a

few general hints, that may be usefully adapted to the purposes of ordinary farms, formed with a due regard to economy as well as to convenience; but we may just add, that in new buildings nothing should be erected but what is actually wanted, and 'there ought not to be the smallest convenience on a farm, down to a pigsty, that is not so precisely on the right spot, that to move it anywhere else would be a loss of labour.'

We may, however, remark, that a very substantial farm-house, with a two-foot wall, and 42 feet in length by 18 feet wide, and 22 feet high, with a roof of slate, sloping to the back wall, and containing a kitchen, cellar, and dairy, have been lately erected in Wiltshire for less than 500*l.*; and the whole expense of offices for the convenient occupation of 500 acres was only estimated at little more than 1000*l.* The stable, the dimensions of which are 60 feet by 20 feet, and 10 feet high in the side wall, being without lofts, is thatched, and cost only 110*l.*; upon which we may observe the economy of those sheds, which answer every useful purpose without the additional cost of lofts, which are unnecessary to the warmth of working cattle, and useless as preserves for fodder.

The barn is 64 feet long; and being placed against sloping ground, contains sheds underneath, while the corn-stack yard, being on the opposite side, allows of free access to the thrashing-floor, which, being considerably elevated, permits a free passage of air under the floor, by which it is kept more sound, and freer from vermin. Another range of open stables, which together occupy one entire side of the farm-yard, are sufficient to accommodate 20 to 30 head of cattle; and these did not exceed the sum we have mentioned, together with cow and calf-pens, pigsties, and poultry-houses, all warmly and substantially covered by boarding, with reed-thatch, together with tiled granaries under the waggon-sheds.

There is also a commodious court of offices extending 146 feet by 130 strongly built and slated, so that they may be expected to last for ages, erected in the neighbourhood of Montrose, on a farm of 400*l.* a-year rent, for 1200*l.* exclusive of the dwelling. That a farmer should have every reasonable kind of accommodation cannot admit of doubt, but the taste for farm-steads on a larger and more expensive scale than absolutely requisite should be avoided as far as possible, as it is a general rule that the tenant is bound for the repairs of all buildings held on lease, and must deliver them in the same style, except customary wear, as they were received. They should indeed be repaired the moment any kind of damage is incurred for which the tenant is answerable; it is cheaper, besides being more respectable, than to allow accounts of repairs to swell until they become inconvenient and occasion disputes with a landlord. As an instance in point, no men are more economical than the Dutch; they hold their lands upon lease, and yet throughout Holland you will not see an occupied farm-house in bad repair.

When masons put on the roofs of buildings, it is generally customary to leave the tops of the walls level, by which means there is a shelf left underneath of considerable space for the shelter of rats and other vermin. To prevent this, as soon as the roof is finished, the bounds of the inside part of the wall should be carefully filled up till it joins the roof, to which it should be closely combined with firm plastering. Slates of good quality form the best covering, but they are expensive, and nothing can be worse than the common sort of pantiles, which are commonly used for barns and stables* In the North, in situations far from the coast, they cannot be

* The Bishop of Llandaff states as an effect of this in buildings covered with common, or unglased tiles, that on immersing two pieces of common tile and slate, which

made to stand the weather, and it becomes necessary to defend them with a covering of heath or straw. In two very able essays on thatching with fern, or ling, and heath, in the prize essays of the Highland Society, it is stated that fern, if laid on in the manner there described, will last on the south, or sunny side of a house, for eighteen or twenty years, and in some instances much longer; while, on the north, its duration cannot be calculated beyond ten; for wet and damp hasten its decay, while heat and dryness contribute to its preservation. But if buildings are constructed as barns commonly are—north and south—their duration may safely be calculated upon for the before-mentioned periods.

The expense of workmanship, as an average applicable to many districts, on a house 40 feet long, and the height of the roof 13 feet on each side, will give a surface of 115½ square yards, the cost of which, for pulling and cartage, and putting on, will only amount to 75*s.* if the fern belongs to the proprietor; but if purchased at a moderate price, the value would not exceed 45*s.*; so that, including every expense, the whole charge would only amount to 6*l.* Heath, if well collected, and in a dry situation, will last quite as long, and the cost is about the same *.

Sea or marsh-reed is of excellent quality, and, when neatly put on, will preserve a roof longer than tile; but, when straw is used for thatch, the practice of the West of England should be observed, where the straw is carefully combed quite clear of weeds, the ears of corn cut off, and laid on the whole pipes unbruised by the flail. Rye, when it can be obtained, is preferable †.

In all palings, battenings, and other fences about the homestall, nothing is more useful than pollards, and they should always be employed on such occasions, because they are commonly the produce of the farm, of little value except as fire-wood, and may be even made to save much better timber in the construction of sheds and small buildings for cattle. All work of that kind should be set, as far as possible, by the job, for a fixed sum, but subject to approbation when finished.

As dryness is a principal preservative of health, as well as of the state of buildings, they, besides a good foundation and perfect drainage, should be raised at least a foot above the soil, and encircled by hard rubbish and mortar, well rammed down, and mixed with broken glass and earthenware. This will probably not only keep them dry, but also prevent the entrance of rats. If that precaution should, however, not have been used, it will not be money thrown away to fill up the joists with a well-tempered mixture of limestone gravel, with glass and clay, or of forge-ashes and brick-dust, a considerable distance, at least, around the interior, and somewhat lower; for the vermin, which have sagacity enough to burrow below the walls, seldom persist much lower. Timber floors, upon the ground, as those of barns, should be removed for examination before harvest-time; and should they be hollow under the sleepers, openings should be made at the bottom to admit cats. All perceptible rat-holes should be immediately stopped with ground glass, or poison, and constant war should be waged against this destructive animal.

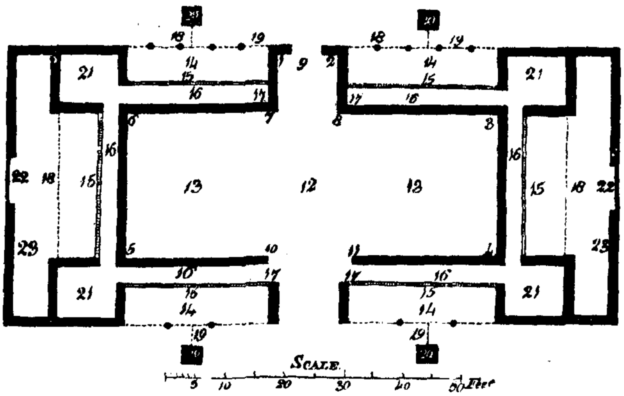
were first separately weighed, when they were taken out of the water the tile had imbibed one-seventh; and the slate only a two-hundredth part of its weight; and on placing both pieces in a room heated to 60°, the slate will dry in a quarter of an hour, but the tile did not entirely lose the water during six days.—Vol. iv. p. 314.

* Prize Essays of the Highland Society of Scotland, New Series, vol. ii. p. 184, on Fern, by David Campbell; and p. 190, on Heath, by John Collier.

† Kent's Survey of Norfolk, p. 115.

BARNS.

There are no offices more important for all the purposes to which they may be used than barns; for although single in the object of their construction, yet their great size allows of their being very economically employed by having erections of smaller size attached to, and under the eaves of the larger building. Thus a common roofed barn, 70 feet in length, and 22 feet in width, may be so extended on each side of the doors of the bays as to form four sheds, of 26 feet in length by 14 in width, under one roof; and gables, of any width, and 50 feet in length, leaving also sufficient air for windows over, may also be added for a mere trifle. It is easy to imagine the various modes in which such buildings may be used, or the economy and the convenience with which they may be constructed; but the following, which was sketched by Arthur Young, for the late General Washington, will afford a correct idea.

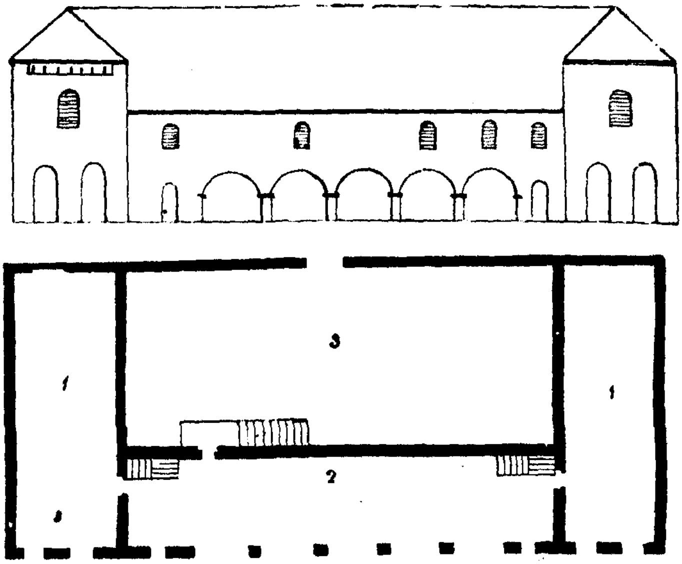


1, 2, 3, 4, 5, 6. The barn.
1, 2, 7, 8. The porch of do., with a small door at 9.
10, 11. The great door at which the carts enter.
12. The threshing floor, which extends the space of 1, 2, 10, 11.
13, 13. Bays, in which the corn is stowed.
14, 14, 14, 14. Sheds for cattle and horses.
15, 15, 15, 15. Mangers, out of which the cattle get their roots, straw, and chaff.
16, 16, 16, 16. Passages, between two and three feet wide, for carrying food to the cattle.
17, 17, 17, 17. Doors into the passage.
18, 18, 18, 18. Principal posts on which the sheds rest.
19, 19, 19, 19. Gutters of bricks sloped for conveying the urine of the cattle to
20, 20, 20, 20, cisterns, from which it is every day regularly thrown on the dunghills.
21, 21, 21, 21, are sheds for various uses.
22, 22. Two yards, with each a shed for shelter, to be applied to any purpose wanted: one for sheep, surrounded with low racks; another divided for a horse or two loose; or the other half for yearling calves.
23, 23. Inclosure of pales.
1, 2, 8, 3, 4, 5, 6, 7. The main body of the barn, which rises from 14 to 20 feet to the eaves; all the rest of the shed being placed against it.

The quantity of cattle-room may be enlarged by a slight extension of the sheds at each end; and all these points may be made to vary according to the views and circumstances of each farmer. The best barns are of timber: they keep the straw sweeter and better for cattle, and the sample of corn is brighter in a ticklish season. Clay or brick walls, though more substantial, are not so airy. If corn heats in the mow, sh[illegible] got in damp, which in catching weather is sometimes unavoidab[illegible] which is nearest to the wall is sure to mould, and the holes which [illegible] into the

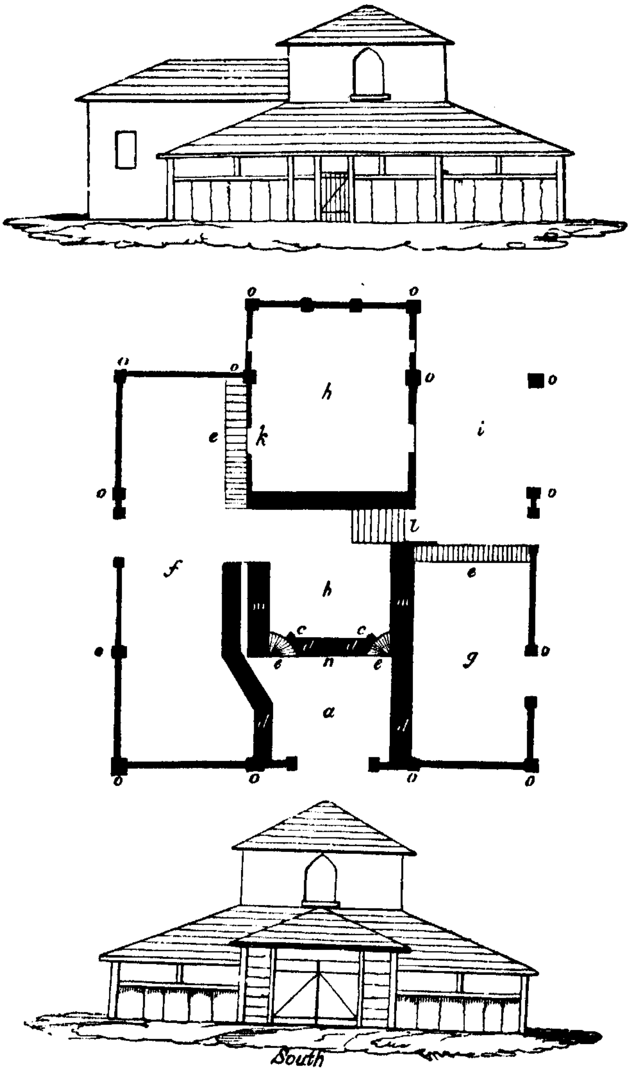
walls for the admission of air rather generate damp than afford a free circulation. When threshing machines are not used, the barn floors should be invariably of oak: the grain yields better under the flail, and it is apt to be bruised upon a hard brick or compost floor. Though not according with us in that, there are some very excellent remarks on the subject in the British Farmer's Magazine, in which it is justly observed, that 'the great object in view in designing buildings for a farm is to get a maximum of room for a minimum of expense *.' The barn in question was erected of brick, for Stephen Langton, Esq., of Lodge-Farm, near Spilsby, in Lincolnshire, for the sum of 350*l.*, his tenant carrying materials. It is 60 feet long, by 24 feet wide, in the main centre, and surrounded by an entire series of dwarf buildings, embracing cattle-sheds, stables, waggon-sheds, straw-house, granaries for a large quantity of corn, and tool-houses of the most commodious kind.

Another, however, of a more solid description, occurs in Yorkshire: the elevation contains a building of solid masonry; the wings, 1, are granaries; 2, cattle-sheds under arches; and 3, the chief building, containing the barn †. It is thus—



But of those upon a small scale, we know of none superior in convenience to a farmery—for we can hardly call it a barn, and yet know not what other name to give it—erected, for his own use, by Mr. Morgan, the respectable agricultural surveyor of Cornwall. The building is placed in an oblong court, of a quarter of an acre, well-fenced round. The south end represents the front; and up-stairs is a wool-room, connected with a fodder-room, which serves occasionally as barn or granary. The gates are much the stronger for being hung low. The elevations are, as will be perce[illegible] the most simple scale of expense, and the plan as follows:—

[illegible] Farmer's Mag., No. xii., Aug. 1829, with a plate of a barn.
† Agri. Survey, of the N. R. of Yorkshire, 4to.



a. Feeding place, upon which the turnips are carried; the carts being backed into it.

b. Stalls for a yoke of oxen; tied to the posts, *c, c.*

d, d. Troughs for pumps.

e, e. Cribs or racks, for hay or straw.

f and *g.* Linhays (open sheds) for store-sheep; or the further end for stores.

h. Fodder-house, used as barn.

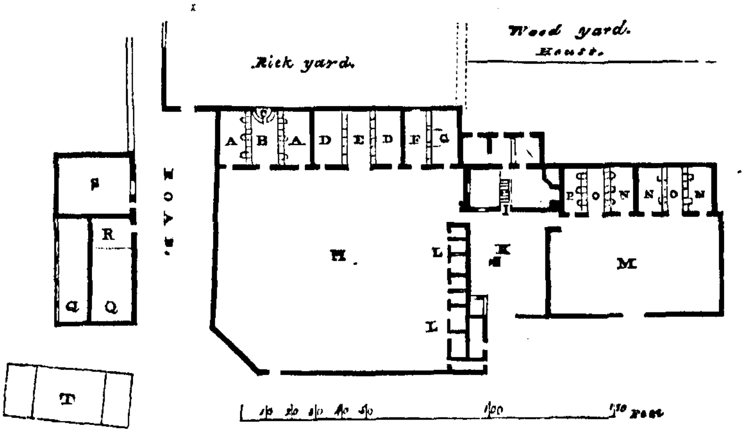
i. Open sheds and implements.

k. Hanging doors, which light the inside; and through which the fodder is handed to the sheep.

l. Door and staircase leading to the wool-room.

m, m. The walls, and the strong post at *n*, support the centre of the building; the outer part rests on the stronger posts, *o, o, o*, and small ones fill up, and serve to hang gates.

Or those on the farm of Mr. Walker, of Killiow, in Cornwall, which possess the advantage of a fall in the ground on which the premises were built; by which means the rick-yard has an elevation of seven feet beyond that of the lower yard, and is consequently above the barns, which are constructed on an upper floor, over the cattle-sheds. The bailiff's house, too, the ground floor of which is four feet higher than the yard, is susceptible of cellarage in the basement by extending the front: a very great advantage both in room, which, being under one roof, is obtained at very light cost, as well as in the coolness of articles preserved in it. This, it will be seen, has been followed in some other plans, and is always desirable when the site admits, for the frontage, being over the cellars, wears a cheerful appearance, while the back entrance, being on the raised ground, is on a level. The following plan will more particularly explain it.



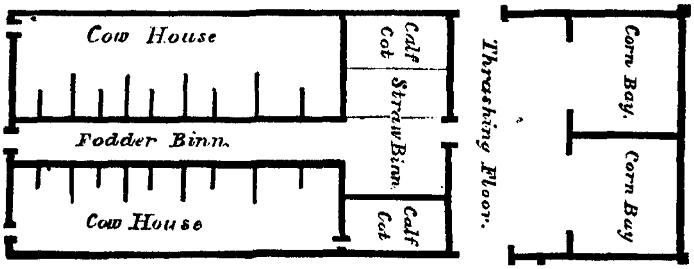
Lower Yard.	H, Lower Straw-yard.	N, Cow-houses.
A, A, Feeding-houses.	*Upper Yard.*	O, Fodder-houses.
B, Fodder-house	I, Bailiff's house, and domestic offices.	P, Calves' pen.
C. Turnip-hutch.	K, Court to do. and pump.	Q, Q, Cart-sheds.
D, D, Working oxen.	L, L, Pigs and poultry.	R, Implements.
E, Fodder-house.	M, Cow-yard.	S, Carpenter's shop.
F, Implements.		T, Ponds.*
G, Waggon-stable.		

Dutch Barns, of the greatest strength and capacity, are, however, to be found in Flanders, and though, perhaps, inconvenient from their size, might, in other respects, be advantageously imitated. The building here alluded to, though appertaining to a farm consisting only of 166 acres, is 130 feet long by 55 feet wide, and accommodates, in its various divisions, all the horses and cows in comfortable stables; furnishing besides two thrashing-floors, and holding a quantity of corn in the sheaf, amounting, in common years, to the produce of about 90 acres. This is piled in compartments to the height of 12 feet, at which elevation an open floor of joists, supported by wooden pillars, extends over the entire area of the barn. This open floor, however, which is particularly worthy of attention, is repeated six times, at every 5 feet in height, at which distance upwards it is braced on pillars supporting every floor, and rising to the top. The corn is therefore not al[illegible] separated into different layers with very little loss of space,

* Survey of Cornwall, chap. iv.

but secured from damage by the great access of strength which prevents that degree of pressure upon the sides which, in other cases, might endanger the safety of the building*.

Offices of this description may, indeed, be most conveniently placed below the barns, whether these be large or small, and whether they be erected upon a different elevation, or upon a level surface; for the corn may in that case be stored above, reserving a threshing-floor and clean straw and corn-bays underneath, with ample space for cattle besides: thus—



GRANARIES.

The best situation for a granary is over the threshing-floor. It may be easily secured from vermin, and, requiring only six feet in height, it will not interfere materially with the bays of the barns, especially if they be loaded through the gables. The roof of the door may be made to project so far as to protect a waggon while loading; or even to continue the flooring of the granary, by which means a barn of moderate breadth might be made to run to the length of thirty feet by twelve, which is far more capacious than the common granaries. A trap-door in the floor, with a rope and pulley, raises and lowers the load in the most easy manner, besides securing it more effectually from depredators; and strong wired windows at each end ventilate it sufficiently. Corn, when either imperfectly dried or allowed to remain too long unscreened, is apt to contract a disagreeable smell; it is therefore important that the air should have free access to the granary: but although that may be secured by the ventilators in every corner of the smaller granaries, those buildings are generally not long enough in the floor to allow of its being completely screened and turned—operations, however, of great importance to the security of a bright sample. Granaries are usually divided into several partitions by deal boards, which may be shifted at pleasure, by which means the different species of the kinds of grain, as well as of different parcels of the same kinds, are effectually distinguished. The most customary mode, however, is to erect them of timber, upon small stone pillars.

It may be almost useless to mention the necessity of securing every sieve and measure for the use of grain, hung upon its own hook, that it may be in readiness. But if there is one thing that demands more particular attention than another, it is corn-sacks, which one sees frequently stuffed with wisps of straw to stop the holes; a disgraceful piece of negligence, the sole consequence of 'the want of a stitch in time,' by which it

* See a Report on the Agriculture of Eastern and Western Flanders, with a Plate containing a Description of the Barn in the Isle of Cadsand, by the Rev. Thomas Radcliff, p. 198.

might have been prevented. Small articles, and those easily wearable, should be carefully put aside the moment they are no longer wanted; but even that is not enough—they should be counted; and if they want repair, it should be done before they are put aside, or it surely will be forgotten.

YARDS.

We deem it unnecessary to give the particulars of the dimensions of buildings for the care of live-stock, of the management of the dairy, or of hops, and several other matters connected with farm-buildings and machinery, farther than they may be already mentioned in the engraved plans, because they will be again more appropriately mentioned when those subjects come to be treated.

An object of more importance is the *dung-pit*; the management of which we apprehend to be less comprehensively understood by common farmers than any other portion of their business. Requiring, however, a chapter to itself, it is only now necessary to recommend that it should be regularly removed from the stable-doors to the yard of the store-cattle *. Not only will there be a certain degree of neatness in the access to the buildings, which otherwise soon become immersed in dung and urine in a most filthy state of fermentation, but, lying in such heaps, the centre is burnt or charred to a dry white substance, and loses in this state a very considerable portion of its value. Were it a regular rule that the yard-man should every day, as soon as he had done his morning work, remove and spread the horse-litter to the straw-yard, there would be little difficulty and considerable advantage in the practice †. The drainage from the stables should be channelled, with a proper fall to the yards, and carried out beyond a paved causeway, which is of great use when it extends around a material portion of the buildings, and should be higher than the centre of the farm-yard, which should be moderately concave, or sloping to the centre. This is very easily secured by a little attention in the early part of the winter, and from thence the drainage is conveyed by communications under the yard to a reservoir for the purpose. The charge is trifling; for an open drain is better than a covered one, being more easily cleaned, and kept freer from rats. It must, however, be admitted, that considerable difference of opinion is entertained on this construction of the yards, and it is the prevailing notion of some very eminent farmers that a good yard should be a dead level, its bottom coated, if possible, with chalk or some impervious substance that will prevent the escape, or filtration, of urine or other moisture. By moving the cribs regularly about it, the whole yard becomes alike saturated, and should be frequently cleaned out, and the dung laid upon some fresh soil, lightly shaken up to promote fermentation ‡. Perhaps it would be too much to ask for gutters under the eaves of buildings, to prevent as far as possible the drainage of rain-water into the yards; though it would be essentially useful.

The *Farm-yard* should be well drained, especially on wet soils, and the private roads on such land would occasionally be the better for an odd day's attention to the levelling of the ruts. The close fences and gate should be also carefully attended to.

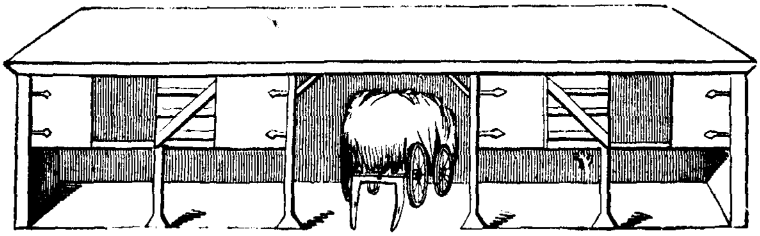
Cart-sheds should be made to open outwards from the farm-yard, or otherwise cattle will get under and do mischief. They should be made high enough to shelter a loaded waggon, and lofts should be constructed under

* See Chapter ix., on Animal and Vegetable Manure.

† See Blaikie on Farm Yard Dung.

‡ Malcolm's Modern Husbandry of Surrey and Kent, &c., vol. i. p. 106.

neath for the care of some of the smaller implements of husbandry, in the following manner.



Sheds, though open, in which cows or other cattle are tied, should be fenced off, otherwise loose cattle or swine will break in upon them and injure them. The modes of fencing consist of dwarf brickwork, or of small piers carried up to support the roof, and gates between them; or of wooden paling or strong open rails and gates. The sheds should be, if possible, open to the south: they should be quite deep and dry enough to cover the animals from the rain, and the floors should be slightly raised to prevent the lodgment of water. The most approved mode of feeding the larger kind of fatting stock is in small sheds with open yards, containing each only a couple of beasts. Although compactness is necessary to be observed in the arrangement of all farm-buildings, yet a very common error often prevails in so cramping the offices as not to allow of sufficient space and shelter for the convenience of live stock. It may, however, be observed that the too great breadth of stables adds considerably to the expense of the roof, and that a width of 16 feet may in most cases be deemed sufficient.

In farm-houses where *the dairy* forms a material portion of the concern, it is important that the buildings should be airy, and detached; yet so near to the dwelling as to be under the eye of the mistress, and to have the command of the back kitchen, if not a boiling house with a regular steaming apparatus, which has now become essential to the preparation of the food of most animals which are supported upon roots, and especially to cows. It should have a north, and, if possible, also an eastern aspect, to guard it as much as possible from the sun; the walls also should be well shaded by a projecting parapet roof; and if the floor were sunk a few feet below the ground, it would improve the temperature of the air.

The *pig-sties* for small farms will also be found useful if placed convenient to the kitchen; for, although not a sightly view, no offal is thus allowed to escape the brood; but on large farms, where they require more regular attendance, it will perhaps be better to place them in a far corner of the yard.

Although *Poultry-yards* are seldom thought of much importance, yet cleanliness and warmth will make a considerable difference in their flavour and product; and if it be possible so to construct their house as to let it have the benefit of a flue from the kitchen chimney, they will greatly profit by it. In this manner the Irish cottars rear vast quantities of that delicate bird the turkey, without any peculiar attention to its food, but merely by allowing it the warmth of a roost in the cottage chimney *.

* See the plan of the poultry-yards at Bradby Park, the seat of the Earl of Chesterfield, in Derbyshire.

On most farms where cattle are maintained, a *root-house* or store-room is appropriated for containing turnips, potatoes, and other vegetables. But as the method of covering up potatoes in the field has been found to answer the purpose, no more spare room is required than is sufficient to contain one of the beds at a time. It is however convenient to have the shed made large enough to admit of a cart being turned up and emptied within it.

Stack-yards should not be inclosed by high fences, for they exclude the circulation of air. Farmers are, in some places, very averse to stacking, and the barn-room in some ancient homestalls, as well indeed as in some newly-erected buildings, especially in Norfolk, has been carried to an extraordinary excess; so much so, that, in some counties, even the hay claims the protection of a slated roof *. Corn, however, is in general much better preserved in the open air. When the stacks are not laid upon piers of stone, or iron, but upon the ground they should be raised upon ridges to throw off the water. These should be paved with rough stones; and they should also have a few bavins or worn-out hurdles underneath to preserve them from the damps; but, take what precaution you may, the vermin will burrow underneath if they have a close cover.

It is, however, a great and a very general improvement in stack-building, to lay them upon low stone pillars, coped so as to prevent the entry of rats and mice, and guard against wet; they have indeed no power of climbing up stacks thus placed, unless through the carelessness of servants, who sometimes leave their forks standing against a rick during the night. It is also a most useful precaution, for the security of corn in doubtful harvests, to furnish the stack with a hollow cone of rafters, or any rough spars of timber to preserve it from heating. This is run up the heart from the ground to the top, or roof, with an opening on one side to admit the free entrance of the air. Stacks are a mere matter of taste in point of form and size; but those of moderate dimensions, say containing 15 to 20 quarters of grain, are the most used and least subject to accident. In the stack-yard at Shaw Park in Clackmannanshire, there are 28 stacks placed on cast-metal pillars, each three feet high, with a *bos* or triangle, drawn from the centre to the roof, to preserve the circulation of the air. Each of these stacks contain 1584 sheaves, and it has been shown by an accurate experiment comparing the same quantity of wheat built on the ground, or on cast-iron pillars, that the saving from vermin and wet, was 2*l.* 12*s.* 6*d.* per stack, which repay their cost in two years. Triangular bosses of wood may also be used, and the corn may be stacked in much less than the usual time †.

The number of *thrashing-mills* throughout the country is very considerable, but they in general seem to have been placed with no other view than that of finding some old barn ready to receive them, and thus using a building every way inconvenient for the purpose; without space for the straw or receivers for the chaff, and still less attention paid to its ready distribution to the animals that consume it. The position of a thrashing-mill should decide that of almost every other office; for it [illegible] the hay into chaff, together with much of the straw; [illegible] receives the chaff ought to be so placed [illegible] [illegible] the stalls and [illegible]. [illegible] [illegible] and horse-stables, [illegible]

* [illegible]
† [illegible]

yard (if there be one), should be dependent on the position of the thrashing-mill, or they will be attended with waste and expense of labour. These and many other circumstances, that merit attention, may be looked for in vain in most farm-yards; nor is it to be objected, that, thrashing-mills being a comparatively new invention, such attentions could not be paid to their erection; for, in the first place, many of the new yards are little better, in this respect, than the old ones; and, in the next, the same requisites are demanded under the old system of flail-thrashing, with no other difference than the floor being the point of regulation, instead of the mill*.

PONDS.

The *watering of cattle*, if not done by ponds, must be conveyed to the yards either by a stream communicating with conduits, or by pump in a well, and must therefore be governed by circumstances. There are some parts of the country, to be sure, where water is not to be found upon the premises in dry seasons, and then tanks become necessary, which must be supplied, as far as possible, from gutters carried along them from the eaves of the buildings, to receive the rain. Chalk is the best foundation for the bottom of a pond: the water impregnated with it is sweeter, softer, and more purifying to the blood, than either spring-water or that which stands upon clay or gravel; but, whatever may be the bottom, care should be taken that it be made close and tight, and that no drainage be allowed to fall into it from the stables or yard, by which the water is rendered filthy and unwholesome, and the straw is robbed of that essence which is to convert it into manure.

It is true, that the observations of many farmers appear to contradict the idea of the unwholesomeness of water thus impregnated, from their remarking that animals frequently prefer it to that which is derived from a pure source. But although that fact be undoubted, it is yet only reasonable to conclude, that the preference arises from some medicinal quality, which though dictated to them by instinct, may be found only occasionally useful: they should, therefore, at least, be allowed the option of a choice.

Although the most common contrivance for the supply of a deficiency of water to farm-houses is procured by means of *wells*, yet their construction requires a certain degree of mechanical science which does not immediately connect it with the present work; but the formation of *ponds* is an object of common occurrence, which can be easily attained without the aid of masonry, by adopting the following suggestion of a foreign journal, by which they have been many years ago brought into common use †.

The first object is to sink them to a convenient depth, which should be sufficient to secure them from speedy exhalation, and should not be less than five feet, nor contain a surface of less than one hundred and twenty feet in circumference. The sides of the pond should be sloped to an angle of forty-five degrees; and while it is digging, a sufficient quantity of moist brick-clay should be incorporated with one-fourth part of quick-lime, which should be slaked the evening before it is used, with as much water as will make it of the consistence of paste; the whole must then be formed into large balls, a couple of feet in diameter. When the cavity is completed and a sufficiency of the balls has been obtained, a labourer is to descend to the bottom, and, commencing as near as possible to the centre, the balls are successively thrown upon the ground with his [illegible], [illegible] thus regularly proceeding to the top, the bottom and sides are com-

* Young's Survey of [illegible]

[illegible]ly lined. If, however, the whole operation cannot be completed in one day, it will be proper to wet the row last applied on the previous evening, in order that it may adhere to, and incorporate with those remaining to be laid on. Two or three days after this lining is finished, it must be beaten with a flat piece of wood, which labour should be continued with greater strength in proportion as its firmness increases, and the surface should be occasionally moistened to prevent it from cracking, till the whole becomes a uniformly solid mass. A coating of common sea oil is then to be applied, on which a stratum of gravel of a few inches in thickness should be laid before the pond is filled. The coating will thus become firm and solid, provided the pond be kept constantly full, as those parts only which are exposed to the air are liable to be damaged by intense frost.

Or by filling the cavity with a stratum of clay, carefully trodden down till it becomes a compact mass from four to six inches in depth, then spreading the whole evenly over with a layer of quick-lime about an inch and a half in thickness, and again covering that with a second stratum of pressed clay, a firm bed will be formed quite retentive of water; stones or gravel are then to be spread of such thickness as will prevent the bottom from being injured by the feet of cattle. Ponds of the former depth and extent may be constructed at a very trifling expense, provided the clay does not require distant cartage, and will last unimpaired for many years, as worms are prevented by the lime from penetrating through the layers of clay and damaging the bottom *.

PLANS OF FARM OFFICES.

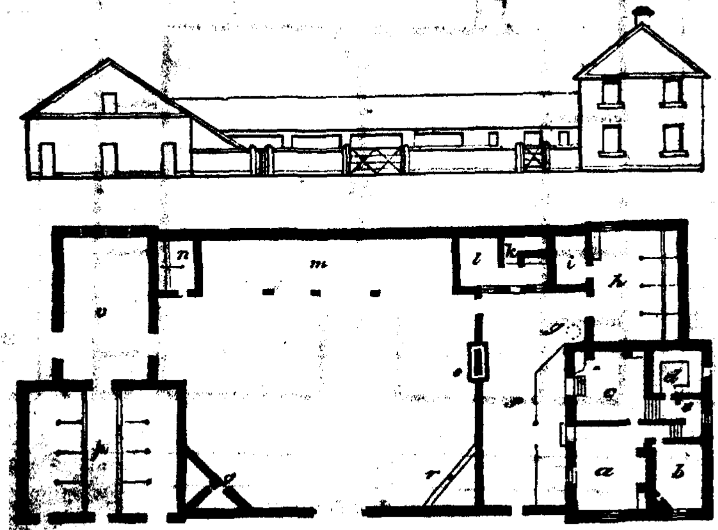
Having thus enumerated the different offices in detail, we now present a collective plan of a homestead, or farm-steading, upon a compact and very moderate scale, which we chiefly select from Mr. Waistell's designs, and which exhibits a comprehensive view of the arrangements of the buildings for a grazing farm.

The interior consists of a yard for the cattle, with a division to keep them from the house, which is there placed fronting the east and south sides. On the ground plan of the house are the kitchen, back-kitchen, parlour, dairy, and pantry; the two former overlooking the yards, and one window of the kitchen, together with that of the parlour, commanding the lawn. The dairy is sunk a few steps from the floor, for the sake of coolness in summer and warmth in winter. The pantry, which is on the same level as the dairy, is under the stairs to the bed-chambers; and under the parlour floor is the cellar, part of which may be partitioned off and appropriated to the storage of roots. The first floor contains four upper rooms, and two garrets in the roof.

Next to the house is a stable for four horses, to which a stall may be added for a nag; the access to which being through the inner court, the cattle are not disturbed in the straw-yard: the gate is placed far from the house, and posts with rails may be added, as shown by the single line, to keep them from the door. A tank for the hog-wash may be placed in the angle formed by the house and stable, or, if necessary, a well may be there sunk, as shown by the dotted circle. Along the opposite side of the yard are the chaff-room, various domestic offices, open sheds [illegible], and calf-pens open to the south: the space within the roof of the sheds may be appropriated for such tools as are only occasionally in use; the [illegible] may be placed over the [illegible].

On the west side are the barn and cow-house; and, as on the farm for which this plan is designed, but little corn is supposed to be grown, the barn may be occasionally used as a potato or turnip store; for the convenience of which there is a door opening into the straw-bin. The beast-house contains standing for sixteen head of cattle, eight on each side of the gang-way; for a feeding-house arranged in a single line with a fodder-ing-passage at their heads would occupy one-sixth more area, and one-fourth more wall. Over the beast-house is a straw-room, and at the back of either that and the barn, or the stable, may be constructed a cart-shed. There is a large water-trough for cattle in the yard; and in the opposite corners are pig-sties for store and fatting hogs.

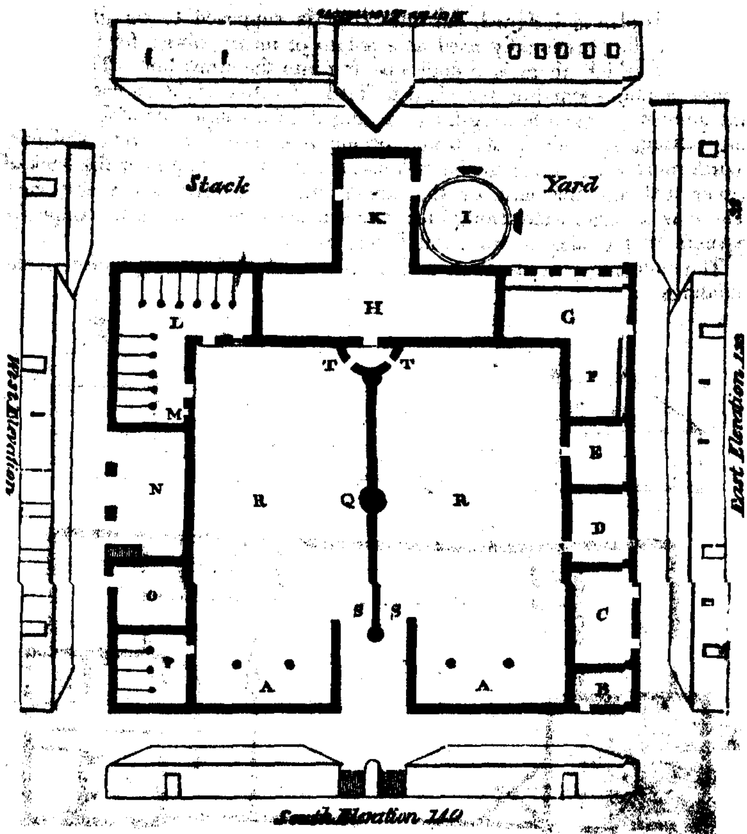
The following recapitulation will afford an idea of the disposition of the buildings.



...itchen.	*g.* Tank or Well.	*n.* Calf-pens.
...	*h.* Stable.	*o.* Barn.
...-kitchen & bakehouse.	*i.* Chaff-room.	*p.* Bullock-house.
...airy	*k.* Poultry-house.	*q.* Hog-sties.
...antry.	*l.* Wood-house.	*r.* Ditto, Store-yard.
...ourt-yard.	*m.* Cattle-shed.	*s.* Water-cistern and trough.

We also add a plan of capacious offices, calculated for a farm of large extent, and extracted from the general report of Scotland, which was drawn up under the superintendence of Sir John Sinclair, and is well worthy attention*. Although not erected, the arrangement has been planned with very consummate judgment, and, though upon a considerable scale, may yet be either enlarged or lessened, to suit the size of the holding: it is as follows:—

* Vol. i. plate viii. In the appendix to vol. i. chap. iii. No. [illegible], will be found very [illegible] directions for the measurement and [illegible] with [illegible] of the expense. There are also various other plans of offices which [illegible] that already given in vol. i.



REFERENCES.

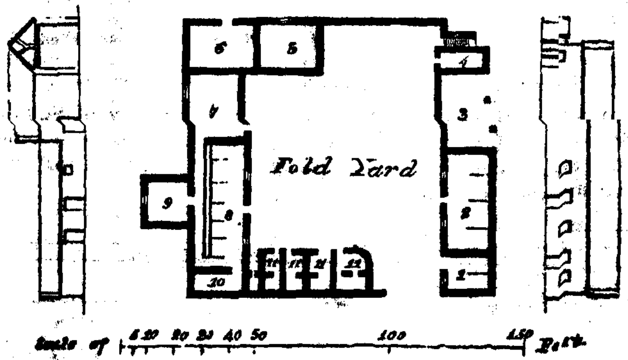
A.A. Open sheds for cattle.
B. Poultry-house.
C. Wood and root-house.
D. Loose stable.
E. Calf-pen.
F. Cow-house and }
G. Fatting cattle }
H. Straw barn.
I. Horse-course to the thrashing machine.
K. Corn-barn.
L. Cart-horse stables.
M. Corn-bin communicating with the granary.
N. Cart-shed, granary over.
O. Hay-bin.
P. Saddle-horse [illegible]
Q. Pump and [illegible]
R. R. Straw-yards.
S. S. Gates.
T. T. Small do. to keep cattle from the barn.

The vast sums which have been expended upon the Marquess of Staffo property, in various parts of Scotland and England, entitle the buildi to particular distinction; not only for their value, but from the judgm displayed in their erection. They have all been built of solid masonr with capacious offices, conformable to the size of the holdings, and w comfortable and respectable dwellings, for which the tenantry are c charged at the rate of 6½ per cent. This plan, it is true, calls indeed the expenditure of interest on the tenant's capital, which is commo [illegible] considered of little value, or is lumped into the farm as of [illegible]. But even were that the fact—though it is not, for there is so thing attached to the possession of every shed which costs anything—

the repairs of buildings in a bad state gradually amount to a larger sum than an annual rent for those in good condition, and it is far better economy to pay the full value for a complete and convenient set of offices. Unfortunately there are but few of that description, and they only seldom admit of new erection; but occasions of the kind must sometimes occur, from which valuable hints may be selected from a few of the plans of which we have been allowed the use:—those of the Marquess's improvement amount already to about thirty; besides which, we may refer to Waistell's work on 'Farm Buildings,' 'Loudon's Cottage Architecture,' and a very complete set of designs from drawings, by order of directions from the Highland Society *.

It is with a view to the different occupations of the ground, as well as the size of the holdings, that attention is requested to the arrangement of the offices, more than with any regard to their elevation; for though generally comprised as near as possible within a square, they will be found, when examined, to contain a great variety of information.

Farm-house, buildings, and mills, at LONGDON, on Tearn, in Salop, 60 acres.



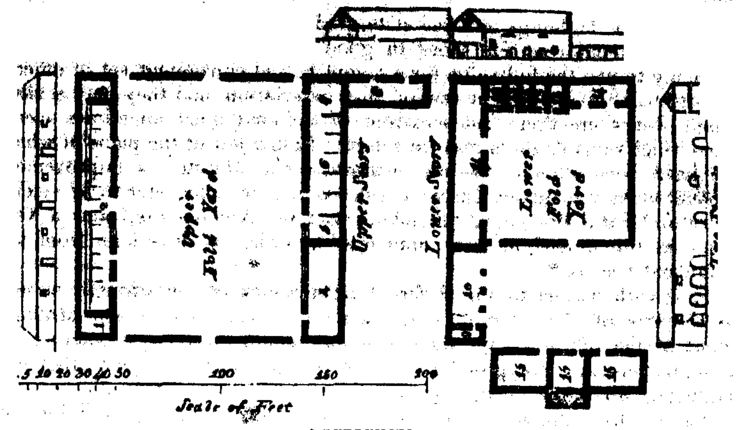
REFERENCES.

1, Hackney-stable.	7, Straw-barn.
2, Waggon-horse do.	8, Cow-house.
3, Waggon-shed do., granary over.	9, Turnip-house.
4, Tool-house	10, Calf-house.
5, Corn-room.	11, Piggeries.
6, Barn.	

The mills at Longdon, though furnished with four pair of stones and a fine command of water, have yet been omitted in the plan of machinery, as being unconnected with the farm-buildings; which, however, for a farm of that size, are considered remarkably snug and convenient.

BURLAUGHTON, in the parish of Sheriffhales, and county of Stafford, consisting of 392 acres, of turnip soil, &c., containing a quantity of water-meadow—the buildings being partly placed on the declivity of a rising ground, part of them consisting of two stories; the cow-tyings being below; the stables above. These offices also contain the advantage of a [illegible] way under one floor. The thrashing-mill is driven by water.

* Published along with the Quarterly Journal of Agriculture, in the Transactions of the Society.

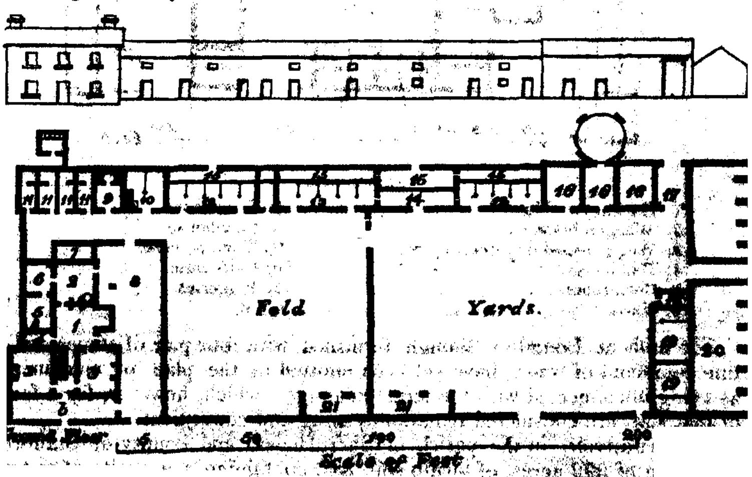


REFERENCES.

Buildings, Upper Story.
1, Hay-bin.
2, Feeding shed.
3, Turnip-house.
4, Granaries.
5, Turnips for cows.
6, Waggon-horse stable.
7, Hay-bin.
8, Sheep-house.

Buildings, Lower Story.
9, Tool-house.
10, Waggon-shed.
11, Cow-shed.
12, Calf-house.
13, Pig-sties.
14, Open shed for young cattle.
15, Thrashing-mill with water-wheel.

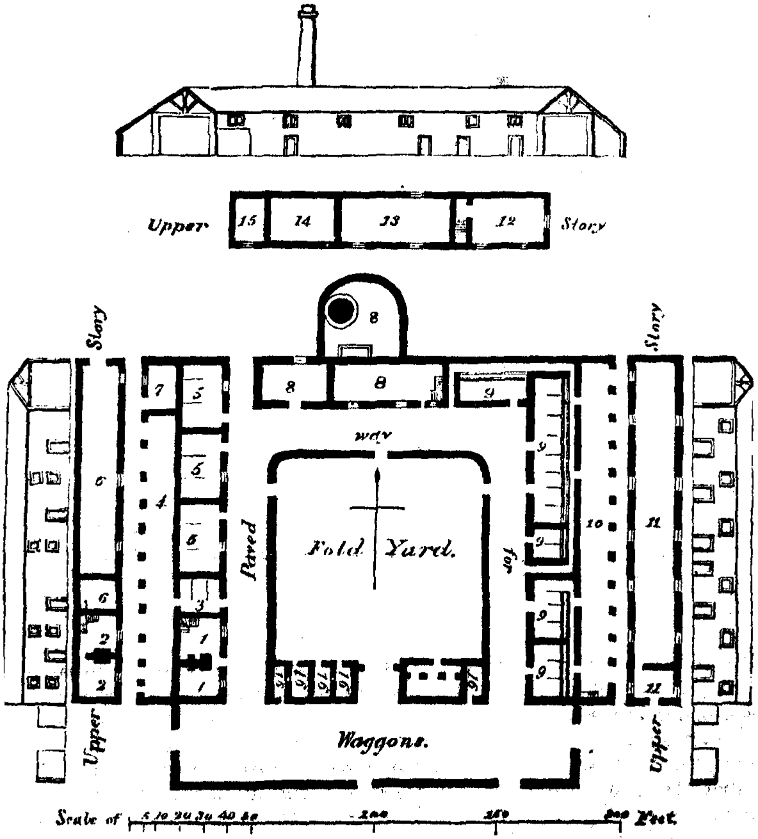
Stallington Grange, in the parish of Stone, county of Stafford, contains 400 acres of a cold and wet soil, but much has been effected by drainage, and it contains great capacity as a stock-farm, for which the buildings are very commodious.



REFERENCES.

[illegible] Stables.
1, Kitchen.
2, Back do.
3, Parlours.
4, Pantry.
5, [illegible]
6, Scullery.
7, Coal-yard.
a, Beds in the upper floor.
b, Flower garden.
[illegible]
9, [illegible]
10, Hackney-stable.
11, Pig-sties.
12, Shed for twenty cows.
13, Ditto for ten [illegible]
14, Calf-house.
15, [illegible]
16, [illegible]
17, [illegible]
18, [illegible]
19, Stable.
20, Waggon-shed.

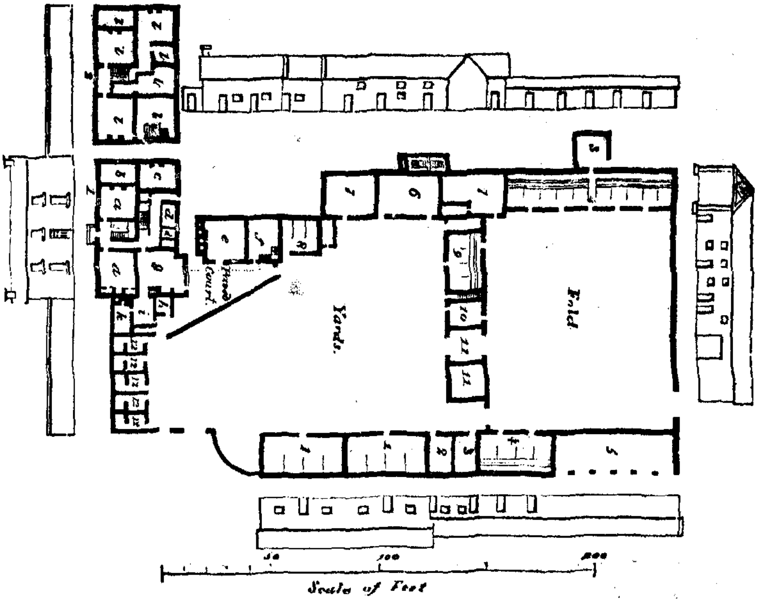
Day-House Farm, parish of Edgemond and Bolas Magna, in t county of Salop, contains 479 acres of very various soil but inclined strong quality. The house and buildings are brick, and slated, and we erected in 1812 for the accommodation of Earl Gower. The granary us in the long room for the annual agricultural dinner, given to the tenants the Marquess of Stafford, is in an upper story of the buildings, which co sist of two floors. The chimney in the upper end of the elevation of tl offices is for the use of the steam-engine, by which the thrashing-mill driven, and the building in the plan No. 8 contains that machine. Th experiment of steam-engines is somewhat new; and although, on large an well-conducted farms, they may answer the purpose, we yet think that considerable time must first expire: but we shall return to the subject on future occasion.



REFERENCES.

1, Men-servants' day-room.
2, Sleeping-room above stairs.
3, Hackney stable.
4, Shed for implements.
5, Waggon-horse stables.
6, Hay-loft.
7, Tool-house.
8, Barn and steam-engine.
9, Cow-houses.
10, Turnip-house.
11, Grand granary, and pay-room. This room used for the agricultural dinner.
12, Small granary.
13, Corn-loft.
14 and 15, Straw-lofts.
16, Pig-sties and poultry houses with various offices.

DONNINGTON, in the parish of Lilleshall, and county of Salop, is of the extent of 380 acres of various, but excellent soil: the house and buildings are brick and tiled, and the thrashing-machine has the advantage of being driven by water.

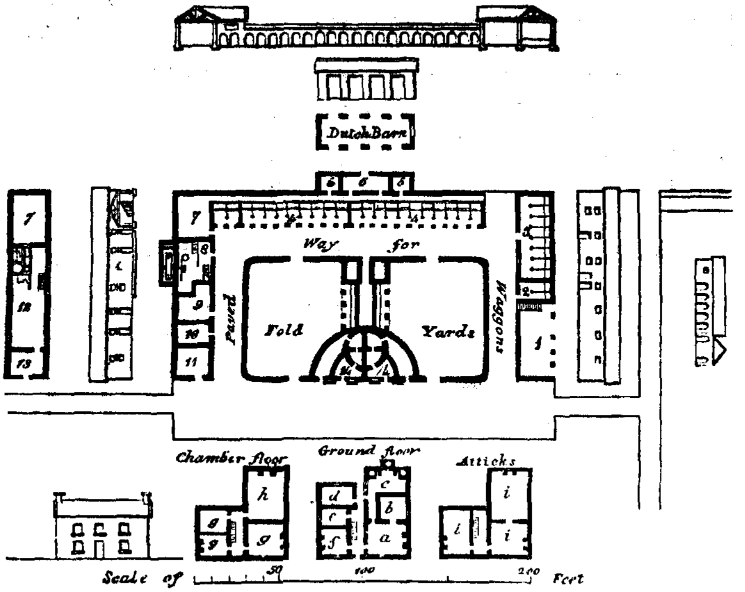


REFERENCES.

To the House.
a, Parlours.
b, Cellar
c, Master's room.
d, Pantries.
e, Brew-house.
f, Dairy, cheese-room over
g, Kitchen.
h, Back do.
i, Court-yard.
k, Bakehouse.
1, Ground floor.
2, Upper floor.
4, Bed-rooms.

Offices.
1, Stables.
2, Fodder-room.
3, 3, Calf-room.
4, 4, Cow-houses, for 28.
5, *Cart-sheds.*
6, 7, Barn and Thrashing-machine, driven by water.
8, Hackney stable.
9, Cow-houses for 8. }*
10, Tool-house. }*
11. Lock-up do. }*
12, Piggeries and Poultry.

The House and Farm-Offices at NEWSTEAD, in the parish of Trentham, and county of Stafford, extends to only 314 acres of a strong and wet soil, which, under a former tenant, was much mismanaged. The land has however been so extensively drained within these few years, that upwards of 23,000 yards of underground drainage have already been completed, together with above 1000 yards of seven feet wide ditching. The farm is therefore now in high condition, and Mr. Ford, the present tenant, is deservedly considered remarkable for his enterprising and judicious conduct. His improvements, however, as on most of the other farms, have been largely assisted by the landlord; and the house and buildings, which are of brick, and tiled, are very superiorly arranged, and in the most complete state of repair. The plan appears as follows—

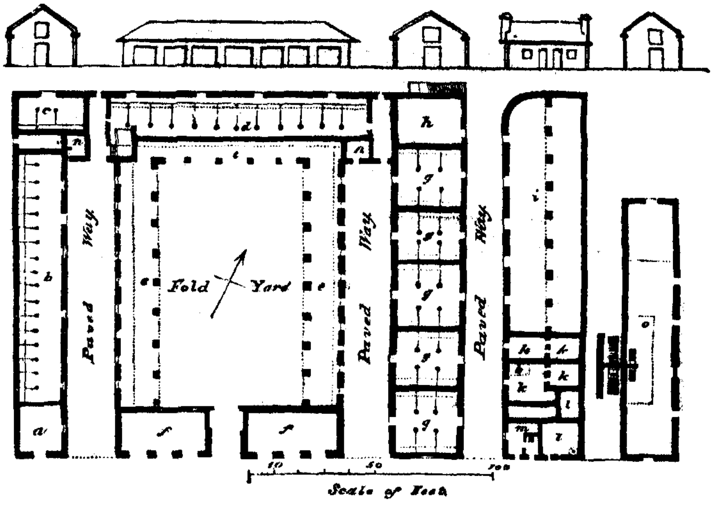


REFERENCES.

House.
a, House-place and kitchen.
b, Master's-room.
c, Brewhouse.
d, Dairy.
e, Pantry.
f, Parlour.
g, Bed-rooms.
h, Store-room.
i, Bed-rooms.

Offices.
1, Shed for waggons, granary over.
2, Hackney-stable.
3, Cart-stable.
4, Cattle-sheds.
5, Turnip-houses.
6, Fodder-houses.
7, Straw-bays
8, Thrashing-machine, driven by water
9, Corn-bay.
10, Tool-houses.
11, Work-shop
12, Bay for unthrashed corn.
13, Small granary.
14, Pig-sties.

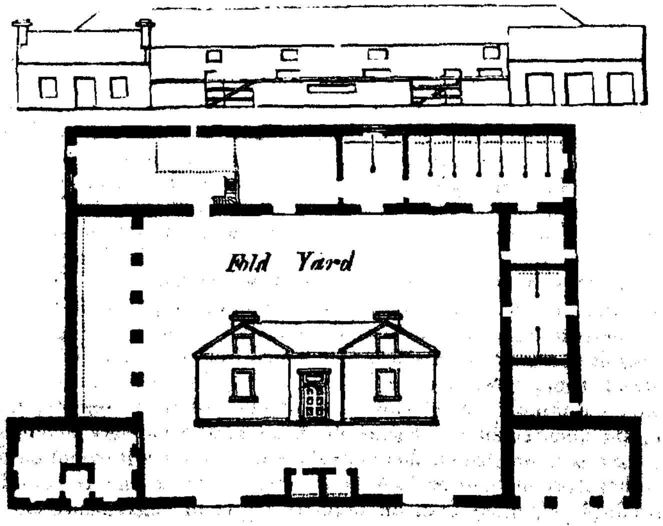
Much of the ground on which the buildings were erected was selected by the Marquess from situations in the county of Sutherland, which contains land of various qualities and beauties; some consisting of the finest arable, and the remainder of the wildest mountain pasture; showing what may be done in a few years by skill and industry properly directed. On the east side of the Moray Frith stands the castle of Dunrobin, long distinguished as the ancient feudal residence of the earls of Sutherland, but now converted, by improvements of a century ago, to a mansion of great comfort and most romantic beauty. In this glen stands the home-farm, or MAINS OF DUNROBIN, consisting of about 500 arable acres. The crops of corn and turnips, which are the admiration of every traveller, though, only a few years ago, the natives of the county were so wholly ignorant as to render it necessary to establish ploughmen from the south of Scotland to instruct them; now, however, in 1832, all the farm-servants are natives, and are hired throughout the county on account of their sobriety, intelligence, and moral conduct. Farm-offices, on a large and very commodious scale, have been erected on this property—and to a great extent on other lands—but those in question have been selected, as the plan is considered to have displayed more than an ordinary degree of convenience and simplicity.



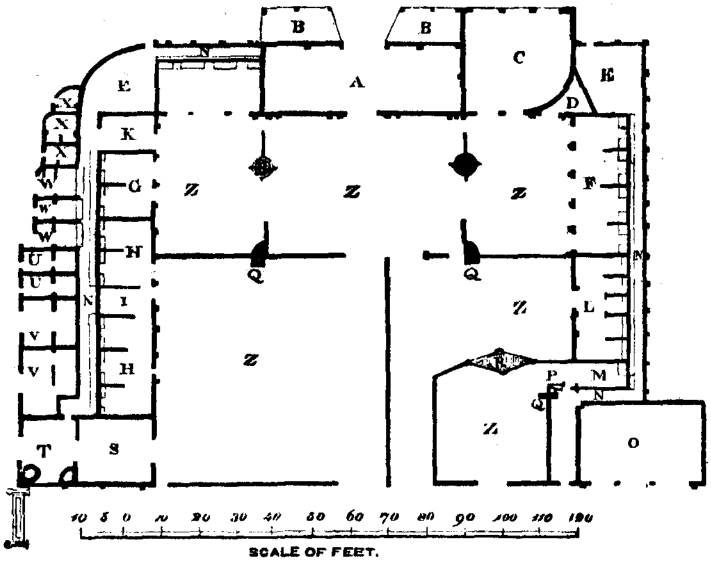
REFERENCES.

a, Carpenter's shop.
b, Stable.
c, Cow-house.
d, Feeding byre.
e, Cattle shed.
f, Cart shed.
g, Cow-house for sixty cows.
h, Slaughter-house.
i, Calf-sheds.
k, Piggeries.
l, Steaming-house.
m, Bothy (ploughman's room).
n, Tool-house.
o, Thrashing-mill, driven by water.

The farm of INVERBRORA, in Sutherland, merely consists of a square of the usual offices, with ploughman's cottage in one corner; and a dwelling-house,—the elevation of which is placed, for the convenience of the engraving, in the centre of the plan,—is inserted chiefly to mark the simple degree of comfort by which the new erections are there distinguished.



That at foot, which is the plan of the farm-buildings at SHEFFIELD PARK, the seat of Lord Sheffield in Sussex, though on a large scale, and very regularly as well as substantially constructed, has been rather selected in order to note the situations of the drains and reservoirs, than with a view to comment on the style of the offices, though these will be found of the most convenient description, and consist of—*



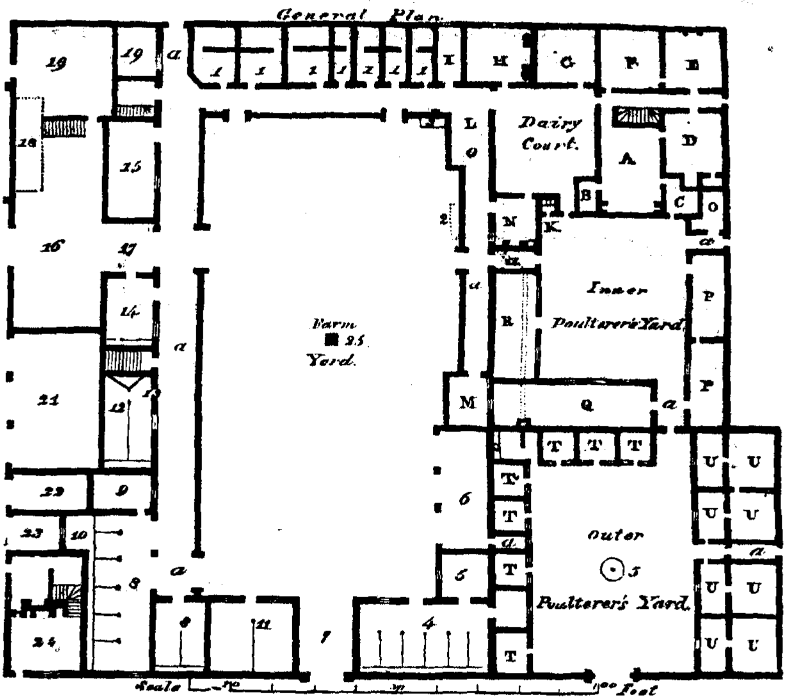
REFERENCES.

A. Barn, with thrashing-machine, corn-mill, and granary above
B B. Sheds for straw.
C. Ox-track for working the machine.
D. Harness-room.
E E. Rooms for fodder.
F. Lodge for 8 working oxen.
G G. Lodges for 10 fatting oxen.
H H. Lodges for 10 cows.
I. Calf-pen.
K. Store-room for grain for fatting hogs.
L. Stable for horses or working oxen.
M. Stall for bull.
N N N N. Passages at the head of cattle.
O. Waggon-lodge.
P. Pump.
Q Q Q Q. Cisterns for water
R R R. Dung-pits.
S. Slaughter-house.
T. Steaming-house and cistern for hogwash.
U U. Hog-pounds for breeding.
V V. Do. for store pigs.
W W W. Do. for fatting hogs.
X X X. Dog-kennels and other small offices.
Z Z Z Z Z Z. Yards for the cattle.

We might also notice those of the very superior offices at HALDON, in Devonshire, the seat of Sir Lawrence Palk, Bart., which, besides their general convenience, are remarkable for a barn of large dimensions and very superior arrangement, well worthy the attention of persons intending to build on a large scale †.

Those of the Earl of Chesterfield, at BRADBY PARK—which follow—are also remarkable for the very simple, yet elegant elevation of the erections of the home-farm; and others abound throughout the reports of many of the agricultural surveys.

* Young's Survey of Sussex, Append.
† See Vancouver's Survey of Devonshire.



Dairy Court.

A, Bailiff's kitchen.
B, Pantry.
C, Store-room.
D, Parlour.
E, Dairy-parlour.
F, Cream dairy.
G, Cheese dairy.
H, Dairy scullery.
I, Salting-house.
K, Water-closet.
L, Pump-yard.
M, Coal-yard.
N, Boiling-house.

Inner Poulterer's Yard.

O, Poulterer's shop.
P, P, &c. Feeding-houses.
Q, Roosting-house.
R, Laying and setting-house.

Outer Poulterer's Yard.

S, Pond.
T, T, &c. Poultry and store-sheds.
U, U, &c. Aviary for pheasants.
a, a, a, &c. Passages.

Farm-Yard.

1, 1, &c. Piggeries.
2, Pig-cistern.
3, Water-cistern.
4, Stable.
5, Hay-bin.
6, Open shed.
7, Entrance, from the west.
8, 8, Cow-houses.
9, Calf-house.
10, Hay-bin.
11, House for sick cattle.
12, Bull-stalls.
13, Stairs to the granary, cheese-chamber, &c.
14, Straw-house.
15, Chaff-house.
16, Barn.
17, Porch to barn, with pigeon-house and clock above.
18, Thrashing-mill.
19, Dressing-floor, corn-bins, and granary above.
20, Mill-race or horse-track.
21, Cart-house, with granary above.
22, House for implements, and wool-chamber above.
23, Turnip-house, and hay-chamber above.
24, Cottage for a farm labourer.
25, Main drain, leading to a reservoir for urine, &c.

On most farm houses there is but indifferent accommodation for poultry, as the rearing of a greater number than can subsist by picking up waste grain is considered unprofitable by those farmers whose wives will not be at the trouble of carrying them to market; and anything beyond one cold apartment, with ill-contrived nests and dirty roosting-places, is seldom thought necessary. Attached, however, to the mansions of gentlemen who calculate differently, poultry houses are found of very considerable

extent. In some of these there is a keeper's house and a range of small houses for the different kinds of fowl, having projecting roofs in front, of three or four feet beyond the south wall, to afford them shelter in bad weather. All these usually open into a court covered with sand or gravel, the inclosure of which is generally about seven feet high, and sharp pointed to prevent the fowl from perching on it. A large open space is also allowed, as considerable room is necessary to their health, when they are not permitted the range of the farm-yard; and the apartment for forcing fowls to lay during the winter is easily warmed by a flue from the keeper's cottage. In the foregoing plan of the farm-offices belonging to Lord Chesterfield, at Bradby, there will be seen the arrangements of as complete a dairy and poultry establishment as perhaps exists in the kingdom. Although, however, we call attention to the plan, as well meriting notice for the many improved conveniences which it contains, we must yet refer the curious in such matters, for the details which necessarily do not interest the more general reader, to the second volume of Farey's Survey of Derbyshire.

The improvements in the construction of farm-buildings have been in no part so great as in those districts of Scotland where cultivation has been extensively introduced, for in no part have small farms been so widely thrown into larger holdings, and a consequent necessity created for the erection of new sets of offices. In no very remote times the *onsteads*, as they are there called, were of a very mean description, and although considerable alteration has taken place, half a century ago, throughout the Lothians and the neighbouring northern counties, yet still there are many situations in which they are very deficient in accommodation. Thus the houses of middling farmers in the Highlands in general, and in those parts of the Lowlands which border upon the mountains, are much circumscribed by the scarcity of timber which there prevails, and many tenants of otherwise good property are wanting in the real comforts of domestic dwelling, and sufficient space and warmth for the healthful occupation of their stock. They consist chiefly in those places, of a line of buildings, in the centre of which stands the house, composed of a single story from thirty to forty feet in length, and about fifteen feet in breadth, divided by a kitchen and a master's apartment at each end, with perhaps the addition of a lower shed as a dairy, cellar, and store-room, and garrets of low dimensions lighted by a small window in each gable. The two principal rooms are warmed by fires, the larger of which, in the kitchen, is covered with a huge overhanging chimney, with a fire upon the hearth, under which are seats for the servants, and store of hams, as usual in farm houses of the south where coal is not used. The flooring of the principal apartment may be of deal, but that of the kitchen generally beaten clay: the height from the ceiling is not more than eight feet; and the device of lath is not used to conceal the beams, which, however, are rendered useful by nailing a few spars over them, by which means they are converted into shelves.

The offices are commonly arranged in one row with the dwelling. The barn being placed in a line with the better end of the house, and the byre, or cow-house, with an entry from the kitchen to afford the easier milking, and poultry-houses over them for the advantage of their warmth. Beyond this is the stable; but although the cattle are tied, there is usually a deplorable want of the common convenience of stalls, racks, and mangers; and in farm-houses in which the servants dwell, when there is not a *bothy*, or separate room for them to live in, the bed-room is not uncommonly formed of a platform over the horses. All these offices are thatched with

heather, or with straw interlaid with thin turf; the walls generally of stone, but as low as possible to permit the cattle to rest under. Behind is the rick-yard; and in the centre of the *midden* extends the dunghill, which being cleaned away but once a year, exhibits its usual mass of impurities, but being exposed to the open air, its noxious vapours are dissipated, and it is never thought to create infection.

Such was the accommodation commonly afforded by farm-houses a few years since, and many of which still remain. Improvements, however, have been made upon the general run of them; and when ruinous, they have been entirely altered. The barn has been converted into a distinct building, and placed at right angles to the dwelling—thus forming a half square with it and generally placed on the windward side to afford the greater shelter. In other instances the square of three sides has been adopted: the farm-house with some out-offices occupy one side, with the front outwards; on the next a line of barns, and on the other a row of cattle-houses, at the farther end of which a wall is erected connecting the square; and others again, as they have grown into more prosperous circumstances, have erected dwellings of considerable pretensions *.

Respecting the farm-buildings in Ireland, but little remains to be added to the observations already made, and inserted in our introduction to this work †. Nothing, generally speaking, can exceed the wretched meanness of the accommodation afforded in this particular, even to farmers in otherwise easy circumstances; and the business of cultivation suffers accordingly throughout all its details, from the want of proper conveniences in the offices. But, although the common class of Irish farmers are generally accused of slovenly habits, this part of their want of management is not so much their fault as that of their landlords; it is, in fact, but a portion of the bad system of tenantcy ‡, and the want of capital, which prevail throughout that country. The main object of the landlord is, with very few exceptions, confined to the one point of obtaining the utmost rent for the ground, without regard to the character or means of the tenant; or else, he lets it on any terms by which he can raise a sum for the supply of his pecuniary necessities. He seldom lays out a shilling upon farm offices of any description; the consequence of which is, that the poor tenant, who holds perhaps only a few acres, cannot afford anything beyond the commonest cottage, with a mud shed adjoining for the shelter of his cow and the pig, or perhaps a stable for his horse of no better description; and the wealthier order even of those who hold leases of a considerable quantity of land, being not bound by any conditions regarding expenditure for buildings, nor allowed for repairs, naturally cannot be expected to lay out more money than they can possibly avoid during the existence of the term. There are, no doubt, many instances of superior sets of offices, but they are rarely in the hands of any other than gentlemen of fortune; and the improvements which have occurred in this particular have by no means kept pace with those which have been made in the culture of the soil, or the live-stock of the kingdom.

* See vol. i. of the Appendix to the General Report of Scotland, chap. iii. No. 8. Description of the smaller sort of farm-houses and offices in Scotland, by the Rev. Dr. Skeene Keith: Survey of Cornwall, Northumberland, Cumberland, Westmoreland, and Berwickshire, chap. iv.: and Rural Recollections, (a most just and amusing account of Ayrshire and the Lothians,) by George Robertson, Esq. 1829.

† British Husbandry, No. 1; Surveys of the Irish Counties, passim.

‡ Ibid., Nos. 1, p. 30, and 11, p. 64.

CHAPTER VI.

RURAL ECONOMY—STATE OF THE POOR—SERVANTS—MANUAL LABOUR.

The first object after entering upon a farm, and the proper stock and implements having been procured, should be, a methodical *arrangement of the labour;* in order to accomplish which, the land, if of different qualities, should be classed, and each kind brought under a regular rotation of cropping suited to its nature, in as nearly as possible equal proportions. Many persons contend that as, either naturally or through former management, there is something peculiar in the soil of almost every field, the simplest and the best mode is to cultivate each separately, in that manner which may best accord with its quality. This certainly affords the greatest room for experiment, and to those who farm more for amusement than for emolument, it also offers the most pleasing variety of pursuit; but a man who farms for profit, and who looks to his occupation as a business, must be guided by other considerations, among the foremost of which is an equal distribution of the work to be performed, which can only be attained by laying off the land in large allotments under some settled course of husbandry. When it is cultivated in the desultory manner alluded to, this can seldom, if ever, be effected; for fields being commonly of different sizes, as well as soils, there is in one year an excess of tillage, and in another of grass, or unequal quantities under spring and autumn crops, and thus the teams are over-worked at one season, and idle at another, to their evident injury and great loss of time, besides an uncertainty in the annual charges which leads to much confusion: whereas by dividing the work as equally as may be between the seasons, the expenses will be not only materially lessened, but will be also brought within the compass of previous calculation.

In the attainment of this advantage, much will depend on the former system of husbandry pursued upon the farm, as well as upon the skill and judgment of the farmer. Time is also necessary. To class a farm judiciously is not the work of a moment, nor can it be effected by the stroke of a pen; but it may be easily accomplished by means of fallow crops, or clover; as wheat or oats may be sown upon either the first, second or third year's ley, and different fields may be held over for either period until all of the same intended class are ready. At first, this may occasion some loss, but the subsequent advantage may be more than commensurate.

The *rotation of crops,* which will be hereafter treated of at large, must necessarily depend in a great degree on the nature of the soil; but whatever course may be determined on, it should be adopted as promptly as circumstances will admit, so as to bring all the arable land into a regular shift, even if, in doing so, some of the fields should be thrown out of their usual round. The *drainage* and *cleansing* of the ground, if it be wet and foul, are however indispensable preliminaries, without which it will be in vain to hope for success. The former, if any great extent of underdraining should be necessary, will require time, and no immediate remedy can be applied; but the stagnation of surface-water can, in all cases where the land is not upon a dead level, be prevented by laying-off the ridges so as to preserve a fall; and even if quite flat, attention in gathering them up, so as to throw off the rain from the crown, with careful water-furrowing, will materially assist in keeping the ground dry. Old ridges are, indeed, frequently found in curves, which appear as if rather

intended to retain than to get rid of moisture, and the operation of altering them is both difficult, and demands the exercise of very sound judgment; but the advantage of straight and well-formed ridges, in allowing a free escape of surface-water, ought to counterbalance every consideration of trouble and expense in effecting the alteration. The cleansing can only be effected by careful tillage, or it may be rather said, by thoroughly summer fallowing every acre that is foul; and, if the soil has been exhausted, a considerable portion should be immediately laid down to pasture. As these subjects will be separately treated in another portion of this work, it is unnecessary to discuss them here: it need, therefore, be only now observed, that whatever may be the cost of such operations at the outset, it will be more than reimbursed by subsequent increase of product and permanent diminution of expense; that the longer they are deferred, the less of those advantages will be gained; and that in these, as in all matters of importance, no half measures will answer the purpose · let one thing be done at a time, but let that be done effectually.

DETAILS OF BUSINESS AND ACCOUNTS.

There are few points more essential to success in any business than *order and regularity* in the *details*. In farming, these are so much under the influence of the seasons, and subject to so many other contingencies, that they are less under control than in manufacturing concerns; but the nearer they are brought to the systematic arrangement on which those are conducted, the easier and the more effectual will be their management. No profit can be expected without due attention to economy of time, as well as money; nor can that be contrived without a settled system adapted to the soil and situation of the farm. Every plan for the following crops should be maturely weighed and arranged before the harvest of those already on the ground, and minutes made of the chief work to be performed, which should be adhered to as closely as circumstances and the weather will permit. A man should even look forward several years, and settle the system he means to pursue, for he who acts only on the spur of the moment is always in arrear with his business, ever in a hurry and doing things by halves: without method, knowledge is comparatively useless; and, in most instances, it will be found a good general rule, not to deviate from a fixed project, even although an alteration may seem to offer superior advantages, for indecision paralyzes every operation, and is one distinctive mark of a bad farmer. Nothing conduces more to order than regularity of accounts: without that, although the amount of profit or loss may be ascertained at the end of the year, by the balance in hand, yet no comparative judgment can be formed of the value of different modes of culture, or different kinds of stock, and one goes on from year to year, like a person groping in the dark, sometimes hitting upon the right, but oftener on the wrong.

So many *forms of accounts* have been already published, and such little use made of them, that it would be superfluous to encumber this brief treatise with a dissertation on the modes of arranging them. Every one who understands figures is competent to frame a scheme for his own purposes; and even those who are not practised arithmeticians can find no difficulty in keeping a debtor and creditor account of all payments and receipts, together with memorandums of the work performed and the crops obtained, the price and cost of feeding stock, as nearly as it can be calculated, and the produce, either for the shambles, the clothier, or the dairy. These, although roughly kept, will be found of essential use in enabling a man to take a clear view of his concerns, and, however deficient in the accuracy

of systematic book-keeping, will materially assist him in the regulation of his affairs. Thus, were a memorandum made of each day's labour in any particular field, with the cost, or value of seed and other separate expenses, these charges, added to the average of those upon the entire farm, such as rent and taxes, would at once show the cost of any particular crop; which, if pursued throughout an entire course, would determine its value in opposition to any other rotation with which it might be contrasted; and in this manner a farmer's accounts may be kept as correctly as those of any manufacturer *. But the entries should be made daily, for, if neglected only for a week, they will be either forgotten, or become too numerous for convenient insertion, and the plan will be altogether abandoned. Farmers may be frightened at the name of *double entry*, but it is extremely simple, and is not only, on the whole, the most satisfactory, but, as it displays a distinct view of the result of each separate transaction, it forms the surest guide for their future adoption or rejection. Most men who are in large business have adopted it; and one very distinguished agriculturist, the late Mr. John Billingsley, attributed the success and the superiority which he attained in his profession, 'to a strict adherence to the plan of not only settling annually the profit and loss of the farm in the gross, but also the profit and loss of every crop †.'

A further enumeration of the various duties which require attention would be both tedious and useless, for they can only be learned in the school of practice, and rightly understood through continued observation: the farmer does not need to be reminded of them, and the novice must be content 'to learn to-morrow's management from to-day's experience, and next year's process from this year's miscarriages.'

The *profit of farming* depends on two objects—economy of expenditure and amount of produce;—the first of which demands the more immediate attention, because the largest returns may be rendered profitless by an injudicious excess in the cost of obtaining them. All calculations of the value of husbandry, whether viewed collectively, or in the several details of its different branches, must therefore be founded upon an estimate of the charges. Among these, that of labour is both the most important in its amount, and the most under the control of management; and this may be considered under the distinct heads of manual and animal labour.

STATE OF THE POOR.

Almost all the answers to inquiries circulated by the Society for the Diffusion of Useful Knowledge concur in representing the *situation of agricultural labourers* in this country as far worse than formerly. The fact is indeed sufficiently obvious to common observation: it has occurred, too, at a time when agriculture has reached an extraordinary degree of perfection; and it is a melancholy as well as a singular truth, that, while the landlord, the tenant, and every tradesman connected with husbandry, have all largely profited by modern improvements, that useful body of men, through whose humble but indispensable agency they have been effected, is the only class which they have not benefited. They enjoy, perhaps, some few luxuries of which they were heretofore ignorant: they drink tea instead of ale, and their wives are more gaudily if not so warmly dressed; but they have fewer substantial comforts than near a century ago, for the same amount of labour will not now command the same quantity of the necessaries of life ‡. Nor does the evil rest here: together

* See No. 7, p. 32, of the Farmer's Series of the Library of Useful Knowledge
† Papers of the Bath and West of England Society, vol. ii. p. 92.
‡ The average assize of the best wheaten bread in London, as entered at the Town-

with the diminution of their comforts, their general character has suffered: that honest pride of independence which enabled them to support privations without seeking parish relief no longer exists; and the demoralizing influence of the poor-rate—*or rather the degrading manner in which it has been administered*, especially in some counties, where wages have been paid out of the rates, and the poor have been let out by their parishes to hire—has broken their former spirit, and destroyed much of that contented attachment to their homes and employers which forms the best security for good conduct. Poaching, pilfering, with many kinds of petty knavery and arts of low cunning, are more common than they were, and the difficulty of procuring trustworthy and efficient farm-servants has become a universal complaint. But here much is to be ascribed to the absurd regulations respecting game. Not perhaps so much to the intention of the law, as it regards the poor—for no man who really wishes well to the labouring peasant can ever countenance his infringements of its enactments, and no admission of even his natural right, if so understood, would alter the question of the impolicy of admitting him to share it—but in respect to the overstrained preservation of the game, and the effect which it has had upon the morals of country people. Formerly, when large preserves were nearly unknown, there was not the same incentive to poaching, as, however plentiful game might be throughout the country, an idle fellow would have had but little chance of adding materially to his gains by its pursuit; but now, when it is held penned up in close covers, and fed in immense quantities, the temptation becomes too strong to be resisted. There is a general feeling too of oppression in the law, which, whether right or wrong, is too general among the middle and lower orders, not to savour much of cruelty in its execution. Neither is the country gentleman much benefited; for he is put to enormous expense for preserves which answer no purpose of the true sportsman, who seeks his game upon the wing, and enjoys the healthful recreation of finding it, instead of supporting the senseless absurdity of the *battue*, in which multitudes are devoted to destruction in covers, by the aid of keepers, with about as much real amusement as if their throats were cut in a poultry-yard.

That this is to be attributed to the pressure of increasing population upon the means of subsistence is, no doubt, to a great extent true; but the same causes ought, it may be imagined, to operate everywhere equally throughout the United Kingdom, and probably would, were the mode of paying farm-servants the same; yet, through the adoption of a different and more equitable system of wages, the condition of the peasantry throughout the greater part of Scotland has suffered no deterioration, and is perhaps as comfortable as their rank in life will admit; though we must acknowledge that the great influx of Irish into the west, and lately even to some of the eastern parts of the kingdom, has trenched upon some of the substantial comforts, and materially lowered the tone and character of the Scottish peasant. In that country it is the almost universal custom either to board the single men in the farmer's house, or, when that is inconvenient, with the married labourers (a plan which is found to render them much more orderly and steady than when they are left to shift for themselves), and to allow the latter a considerable portion of their wages in meal and potatoes, at a fixed and moderate rate, whatever may be the market price; or a plot of ground for the

Clerk's office, from 1735 to 1750, was 5½*d.* per quartern loaf of 4lb. 5oz.; and the wages of a day-labourer, in most parts of the country, was from 6*s.* to 8*s.* The assize no longer exists, but the quartern loaf, of the same quality, cannot now be purchased—in January, 1833—under 8½*d.*, though its weight has been reduced to 4lbs., and wages [illegible]

purpose of growing the latter. This, together with the keep of a cow, and the carriage of their fuel gratis, added to an economical diet*, both enables them to support their families in much comfort and decency, and, by removing the temptation to improvident expense, as well as the necessity for constant marketing, which leads to so much idling and gossiping among the females in other places, is one great cause of the regularity of conduct and domestic order for which the Scotch peasantry are remarkable. Not only is the condition of the labourers, thus partly paid in the necessaries of life, far superior to those whose wages are wholly paid in money, but they are generally found more faithful to their employers and more attentive to the interest of their families. Many of the County Surveys agree in this description: one reporter says, 'there are few of this class who cannot read, and most of them can write a little; none of them fail to have their children instructed in these necessary branches of education, while many of them get them taught a few of the rules of arithmetic. One sees, about every farm-house, a number of children, vigorous and healthy, decently clothed, and exhibiting every appearance of being well fed; and not an instance occurs of any of these people soliciting relief from the public, unless when they are, by some accident, disabled from future labour, or overtaken by the infirmities of age †:' while another draws a very unfavourable contrast to this account of the condition of those who are entirely paid in money ‡. See "Supplementary Note," No. 5.

Our northern neighbours are not generally accused of prodigality or inattention to their interest; and, without supposing them to be at all deficient in the duties of humanity, it may be fairly presumed that the same keen perception of the value of money, which they are said to display in other instances, would not allow them to throw it away in this: we may therefore conclude that the degree of attention to the welfare of their peasantry, beyond that which is commonly manifested in this country and in Ireland, is the result of calculation, founded on close observation of its beneficial effects on their own prosperity; a result which no one who has had an opportunity of comparing the effect of the two systems, and who is aware of the value of sober and orderly servants, can for a moment doubt.

The stipend now granted to each family is said, by Mr. Sellar, in the account of his extensive farm in Sutherland, to be, 'during the year, a house and garden, a milch cow, at all times well fed, 13 Scots bolls, or 16½ cwt. of oatmeal, three Scots bolls, or about three cart-loads of potatoes, a limited quantity of English coals of the best quality, and to each ploughman an average of about 10*l.* wages in money. For the above

* The greater portion of the customary food of the Scotch and Irish peasantry, and of many in the English northern counties, consists of oatmeal and potatoes. The meal is boiled to the consistence of a pudding, and in that state forms the *porridge* of Scotland, the *stirabout* of Ireland, and the *crowdy* of Northumberland. It is generally eaten with milk from which the butter has been taken, or sometimes with beer, butter, or molasses; and in either way a quart of it will go as far, and make a more comfortable repast, than a wheaten loaf that costs twice as much. It is considered very wholesome, and is very commonly used in gentlemen's families as breakfast for the children.

As to potatoes, although it has been affirmed that the quantity of wheaten flour which may be purchased for the money that any given quantity of potatoes would cost, at the ordinary prices, would afford more nutriment,—and it has been thence inferred that the best bread is a cheaper food for a poor man,—yet the comparative weight of the former is a consideration that should not be overlooked. A belly-full of potatoes is better than half a meal of bread, even supposing the latter to contain more nourishment; and any one who has witnessed the abundance of even an Irish cabin, in which, with milk, they are the only food, would be apt to alter any opinion he may have formed of the superiority of bread, unless it can be procured in equal sufficiency.

† Somerville's Survey of East Lothian, p. 208.

‡ Robertson's Survey of Mid Lothian, p. 168.

allowance each family keeps a young man within the house; and if any circumstance put two young men to lodge with one of the families, there is allowed 6½ bolls of oatmeal, one boll of potatoes, 52*s.* per annum, and some coals, for the additional lodger *.'

This of course differs in some places, according to circumstances and agreements. In Berwickshire and some of the bordering counties, where wages usually average higher than in most other parts of the kingdom, each married hind has permission to sow a peck of flax-seed, the hand-culture of which, and of a small potato-crop, devolves upon his wife and children, the ploughing being done by the farmer; and the gains of a family, at the prices of 1806, are thus enumerated:—

	£	s.	d.	£	s.	d.
Actual allowance in money	2	0	0			
Do. 60 bushels of oats, at 3*s.* 6*d.*	10	10	0			
Do. 24 bushels of barley, at 3*s.* 8*d.*	4	8	0			
Do. 6 bushels of peas, at 4*s.* 8*d.*	1	8	0			
				18	16	
Estimated value of the keep of a cow, at 6*d.* a day	9	2	6			
Do. of potatoes	2	0	0			
Do. of flax	0	10	0			
Do. of poultry	0	10	0			
Do. harvest allowances	1	10	0			
Do. carriage of 4 cart-loads of coals	1	0	0			
				14	12	6
Probable earnings of the wife, 120 days, at 10*d.*	5	0	0			
Do. of two children, do. at 8*d.*	8	0	0			
Do. do. of spinning and barn-work during the winter	4	7	6			
Value of the wife's food during harvest, 28 days, at 10*d.*	1	3	4			
				18	10	10
Making their yearly earnings amount to				51	9	4

exclusive of the value of the cottage and garden, for which the hind's wife is generally bound to shear during harvest without wages, but with full harvest food, and to work at all customary out-door labour at the common wages of the country. But were these allowances estimated at their value in 1807, the sum would amount to 58*l.* 10*s.* 10*d.*, and in 1808 to 10*l.* more, thus keeping pace with the rise which took place in those years; besides that, when provisions are dear, the peasant who is thus paid profits by the hardness of the times in the sale of his surplus corn, and other articles which he has to dispose of, and which he thus learns to economize †. It may, indeed, be said, that this mode of payment is only equivalent to an advance of wages, which are always supposed to be governed by the price of corn, as the common representative of the necessaries of life; but however true that principle may be in theory, it can only be carried into effect upon the broad average of a series of years; for wages cannot be always regulated according to the constantly fluctuating prices of grain, and, in practice, it is contradicted by the experience of the present moment. It is also a mistake to suppose that the entire difference between the market price of the articles supplied to the labourer and that at which they are charged, comes out of the farmer's pocket; for there are charges on sale and delivery which he saves; and although the labourer, if forced to pur-

* Library of Useful Knowledge, Farmer's Series, No. 18, p. 69. See also No. 12, p. 47.

† *Kerr's Survey of Berwickshire*, chap. xv., sect. 1.—In Northumberland the allowances appear to be nearly similar, with the exception of wool, instead of flax, for spinning, and some wheat and rye for bread, in lieu of a portion of the oats.—*Bailey and Culley's Northumberland, 3d edit.*, p. 164.

chase, is sure to pay the highest price, yet the farmer can seldom obtain it. In some parts of England, the plan of supplying the poor with a quantity of flour in proportion to their family has been occasionally adopted in seasons of distress ; but then it has been made a parish business, attended with all the inconvenience of an assessment, and exposed to the objection of its converting the labouring peasant into an object of charity.

In making these remarks, it is not, however, intended to recommend the plan so much advocated of late years, of furnishing the labouring poor with patches of ground for the general purposes of cultivation, or even with meadow-land for the keep of cows. There can be no doubt of the benevolent intentions of those who propose that measure ; but the propriety of its adoption, except under the peculiar circumstance of the labourer being entirely destitute of other employment, and that his whole subsistence is to be drawn from the culture of that land—is liable to the objection, that by making him partly independent of hire, he would probably be rendered dissipated and idle, and consequently useless to others, while, not having a sufficiency for his entire support, he would himself become a worthless pauper. Unless, therefore, in the case already supposed, the quantity of land should, on the contrary, be limited to a very moderately-sized garden, and a plot for potatoes, not in any case exceeding a quarter of an acre, for which purpose there are slips or hooks of ground on every farm, which might be spared without inconvenience. A potato crop is, of all others, the most valuable to a cottager; the land, too, may be dug and planted at a season when his services are the least required by his employer, and it may be hoed and weeded at leisure hours by his family.

With regard to *cows*—meadow-land cannot always be spared for that purpose; but when it can, it is far better that they should be maintained by the farmer, at a stipulated rate, for the servants' use. When kept by cottagers themselves, it is seldom that they have sufficient ground for their entire feeding ; and, under pretence of pasturing them in the lanes and by road-sides, they are allowed to stray about the country, and, under cover of the night, are often turned into the neighbouring hay-fields, and sometimes even into standing corn, besides many other depredations committed by their owners upon turnips, and other field crops, for their support. All that the poor may be said actually to want from the cow is her milk, for that cannot be generally purchased, while butter and cheese may always be had for money ; and it has frequently happened that, from their too great abundance, village cows have not nearly paid their expenses *. It would, therefore, be most desirable that they should be supplied with a certain quantity, in proportion to the number of their family. Skimmed milk answers every necessary purpose ; and were this sold at a halfpenny the quart, each party would be benefited. Most farmers object to dispose of milk; some from dislike of the trouble, or a churlish desire to keep it for their pigs; others from neither choosing to sell such a trifle, nor yet to give it away. But the objection to sell is only a false pride, which may be corrected by the example of persons of the highest rank, who have condescended to fix a price upon the produce of their cows for the accommodation of their indigent neighbours †; and to give it away would be false generosity, for one great point in dealing with the poor should be to make them as little as possible objects of charity, and, by impressing them with

* *Kerr's Berwickshire*, p. 105. *Mavor's Berkshire*, p. 75.

† Among many others who could be cited, this plan has been long adopted by the Marquess of Bath, at whose seat at Longleat several cows are kept for the express purpose of supplying the poor with milk at a fixed price.—*Mavor's Berkshire Survey*, p. 76, *and Bath and West of Eng. Soc. Papers.*

the value of self-dependence, to teach them that first great principle of moral rectitude, self-respect.

SERVANTS.

Farm-servants are commonly accused of *stupidity* and *obstinacy*. They may not, indeed, be quite so "wide awake" as mechanics, who, by means of greater intercourse with towns, and latterly through clubs and societies, have more opportunities of acquiring general information; nor is it, perhaps, desirable that they should; but they are far from deficient in natural shrewdness, or in cunning enough to take any advantage for which a want of acquaintance with country business, or the negligence of their employer, may offer occasion. They require sharp looking after, particularly at first; for, on coming into a place, they seldom fail to try how far they may impose on the easiness of their employer; and it is only by checking them at once, and showing them that they must perform their duty, that they can afterwards be prevented from evading it. Watchfulness is necessary in every department in which they are employed, for they are frequently in a league together to defraud. The ploughman probably has his sweetheart in the house, who will not hesitate to secrete dainties wherewith to pamper her lover; the carter steals corn for his horses, and the thresher for himself; and whether in the kitchen, the stable, or the barn, the utmost vigilance is requisite to guard against the plunder to which an unsuspicious master would certainly be exposed. Formerly, it was customary to keep at least all the carters in the farm-house, the importance of having them always with their teams being thought superior to every other consideration. But farms were then generally on a much smaller scale, and farmers, living in a more homely style than at present, were enabled to keep a stricter watch over their household. Since the change of manners which has taken place, it has, however, been found more convenient to pay weekly wages to the out-door servants, than to board them; and the single men, being thus left to chance and the public-house for their lodging and meals, acquire habits of idleness and vice. Although it be admitted that the country has benefited by the opulence and skill of great agriculturists, yet their wealth and education, by withdrawing them from all social intercourse with their servants, has deprived the latter of one of the most obvious means of improvement. Few who recollect the rural life of former days, but must regret the annihilation of that ancient race of "round-frocked yeomanry," who presided at their kitchen-table, surrounded by their family and domestics; and it is hardly to be questioned that its decay has had a most prejudicial effect on the character of the peasantry. But with the diminution of capital, somewhat of the simplicity of living of former times is coming round; and the period is, perhaps, not far distant when farmers will be again seen at their own board, dispensing to their dependents, through their own example, and the proper restraints of order and decorum, that moral education which is of more worth than any other kind of learning.

It has been well observed, that, in proportion to the general decency of servants and dependents, is their general usefulness in their several stations; and, in order to have them the most actually useful, to acquit themselves with judgment and dexterity, and, indeed, with that degree of taste which every field employment requires, or admits, they must have acquired strong habits of order. This gives men of every station a bias to exactness and propriety in every part of their labour, and the more they have been so practically accustomed at home, the more habitually will they aspire to ex

cellence abroad. Whether the business to be done be the cleansing of a stable, a pen, or a fold for cattle, of a farm-yard, a pond in the field, the making or mending of a ditch or drain, the planting or plashing of a hedge, the mending of a road, or whatever else in the common offices of the labourers; any, or all of them, will be done the better by how much the labourer has been accustomed to value conveniences and the appearance of neatness in and about his own dwelling. If he be accompanied in his labour by one or more of his own children, they will naturally emulate the taste of their father, and they will, in general, not fail to carry those ideas of useful exactness alternately from the cottage to the field, and from the field to the cottage *.

Regarding the *dishonesty* of *character* attributed to the English farm-labourer, long experience teaches the reflection that it arises, in a great measure, from the generally harsh conduct observed by the master towards his men, and the want of proper confidence which should be placed in them. Nothing is more remarkable than the overbearing behaviour which the middle classes of Englishmen—especially of the agricultural class—generally exhibit towards their inferiors, producing a corresponding bad feeling on the part of the servant. The more opulent tenants are not the harshest masters: this, no doubt, must be attributed to the superiority of their general manners; but the fact is, that the whole agricultural population requires a better system of education.

As to the *obstinacy of labourers*, it has a very obvious, and a very justifiable source. They have been used to a peculiar mode of doing their work; they perform it with comparative ease to themselves, in the manner to which they have been accustomed, and in favour of that they are naturally prejudiced. Could they even be convinced that a change might be beneficial to their employer, they must also be satisfied that it will benefit themselves, or there can be no fair reason why they should adopt it. In case, therefore, of any projected innovation, it should be coupled with their interest, for that is the only real stimulus to any man's exertions in the common concerns of life. A kind word may do something; reason and a draught of ale more; but the only certain reliance is to be placed upon a shilling. Let a trifling addition be made to his wages, and the labourer's objections to a new plan will soon vanish. Encouragement, of this substantial kind, is the surest way to secure good servants; but it should be sparingly administered, and never except for extra exertion. Ignorant people are too apt to regard spontaneous favours as rather due to their own merits than to the generosity of their master, and if not thus frequently indulged, they become discontented and sulky. The full performance of their regular duties should, therefore, be rigidly exacted for the stipulated remuneration; but occasion may be found to show them little acts of kindness, without increasing their sense of self-importance: the continuance of their wages, instead of sending them to the parish, in cases of occasional illness, or some assistance at the lying-in of a wife, or on the death of a child, cannot be misconstrued; and, although the poor are charged with ingratitude, can hardly fail to engender feelings of respect and attachment.

The opinion of steady old labourers should not be disregarded: they are often better acquainted with the qualities of the soil on which they are employed, than those to whom it belongs; and they are generally pretty exact chroniclers of former crops and management, from which many useful hints may be gathered. But they should not be permitted to decide an operation, and an order, once given, should never be retracted in consequence

* Introd. to vol. viii. of the Papers of the Bath and West of England Society.

of their advice; for all discipline would be at an end were they ostensibly allowed to interfere, and it is even better to go wrong than to lose proper command. Firmness and temper are the two great requisites in the control of servants: or, according to the advice of a very experienced farmer, and close observer of human nature, it is a good general rule, to

'*Treat them as* MEN; *but not as* INTIMATES; *nor yet as* MACHINES.'

'For, in a country tolerably free, let fate and fashion say what they will, mankind—as men— are nearly on an equality. and, in this country, how machine-like soever a day-labourer may appear under the immediate eye o an austere master, he is a free agent at his own fire-side, and an Englishman at the ale-house *.'

THE MANUAL LABOUR

Of a farm is performed by two descriptions of servants—*yearly labourers*, which includes the carters and ploughmen, the shepherds and herdsmen, together with the females engaged in house-work and the dairy; and *day labourers*, in which class are comprised all those, whether men or women, who are employed in hedging and ditching, hoeing and weeding, turning and spreading manure, harvesting and threshing, and all the common duties of husbandry, whether at regular wages or by task-work.

Although hired by the year, the former are, throughout most parts of England, discharged a few days prior to the expiration of the term, which always occurs at the same period in particular districts—very commonly at Michaelmas; and, in some seasons, being in the very height of harvest, causes serious inconvenience. The custom probably arose at a very remote period, when intercourse in country places was unfrequent, and an annual *Statute fair* afforded an opportunity to both masters and servants to change, if so inclined; and it has been continued in order to prevent persons belonging to other parishes from claiming a settlement in case of their becoming paupers; to which they would become entitled after a year's continued residence, but which is avoided by their discharge, although they be re-hired. It is a bad practice, tending to render servants fickle and unsteady in their places, and occasions much interruption to country business.

All the females of this class, and sometimes a few of the unmarried men, are boarded by the master, and receive yearly wages besides, varying from 4*l.* to 12*l.*, according to their sex and capacity. But the married labourers, who reside in cottages of their own, are paid weekly, at various rates, depending partly on the price of provisions, the season, and the custom of the country: in England, almost invariably in money, which, at the ordinary rates of nine to fourteen shillings, amounts to

		£.	s.		£.	s.		£	s.
22 weeks, in winter, ...	at 9*s.*	9	18	at 10*s.*	11	0	at 12*s.*	13	4
26 ditto, in summer, ...	at 10*s.* 6*d.*	13	13	at 12*s.*	15	12	at 14*s.*	18	14
Harvest month..................		3	3		3	12		4	4
Ditto beer and supper (when allowed)		1	1		1	1		1	1
		27	15		31	5		36	13

For this the usual hours of work are—from sun-rise to sun-set in winter, and in summer from six to six (except in harvest it is very commonly continued from five in the morning until night), with intervals of half an hour and an hour at breakfast and dinner: but carters are necessarily employed both earlier and later in the stable.

The advantages of a regular and judicious *division of labour* are too generally understood to require illustration. It is evident that the man who

* Marshall: Minutes of Agric., 4to. edit., Append., p. 39.

devotes himself solely to one object, must acquire greater proficiency in that, than if he applied himself to several, and that he will go through more work, and do it more effectually, than if his time be frittered away in a variety of occupation. This is so well known in manufactories, that the workmen are always confined to some particular branch of their trade: it is said, that eight are employed in the fabrication of a pin; and that he who fixes the head, knows nothing about sharpening the point; but the celerity with which the work is performed, and the perfection in which the article is produced, more than compensate the number of hands employed. In farming, this degree of exactitude is impracticable, for the objects to which it extends are so multifarious, and the number of persons engaged, upon any one farm, are so few in proportion, that—with the almost sole exceptions of shepherds and dairy-women—they are necessarily required to perform a variety of duties, and it is, therefore, of great importance so to direct their labour, as that time shall neither be lost for want of occupation, nor in determining how it shall be directed. Exclusive of the general plan of management, every farmer, who understands his business, of course lays out, at least on the previous night, the intended work for the ensuing day; but as this may be impeded by the weather, a man, 'who has an eye to everything,' always holds a number of jobs in reserve, to prevent his people from standing idle. It is this minute attention to details, which distinguishes the active and prudent manager from the sloven; and it is in that, as much perhaps as in scientific knowledge of husbandry, that its profit consists: economy of time is economy of money; and it should never be forgotten that, when wages are to be paid, an hour wasted is so much actual cash thrown away.

Another most material point is, so to adjust the *number of labourers* to the kind of work to be performed, as that they may not only be constantly and fully occupied, but, so far as it may be practicable, in separate departments. For this no rule can be laid down, for it depends not only on the kind of cultivation, but also on the nature of the soil: arable land evidently requires more hands than pasture, and heavy soils demand greater strength of cattle than those which are light; but the latter, when under an alternate course of drilled crops, occupy more hands in hoeing and weeding. Each plough-team must necessarily have a ploughman: if four horses, or a proportionate number of oxen be used together, they must also have a driver; or if in pairs, then two ploughmen: but, in the former case, one man and a boy are sufficient, and in the latter, two men are required—a carter, or ploughman, and his mate; the former being entrusted with the care of the cattle, and receiving additional wages. These, with a constant day-labourer and a boy to every 100 acres of arable, will generally be found sufficient for the regular work on that and a due proportion of meadow; but on large holdings, where grazing or the dairy forms a part of the system, breeding flocks can only be confided to experienced shepherds, and both store-cattle and cows, if kept beyond a small number, also require separate attendants.

Much of the extra labour, of hedging, ditching, draining, hoeing, weeding, and other matters which only occur occasionally, is, perhaps, more cheaply, and certainly more conveniently, as well as more expeditiously, done by contract; which is in some districts called '*by the piece*,' or by '*task-work*.' But then a man should be a good judge of its value, or he will surely be over-reached in the bargain; and although labourers, when thus engaged, need less looking after than those who are hired by the day, yet, if left wholly to themselves, they are very apt 'to make the

most of a job,' or, in other words, to execute it imperfectly. In all field labour, too, as weeding, reaping, and hay-making, where gangs are employed, the utmost vigilance is necessary to prevent their loitering. Few persons have doubted the advantages attainable by this method; but those who have gone either indolently or improperly about the letting of their labour, have often complained of its being slovenly done, and of the proneness of the men to cheat when so employed. This is to be expected in all kinds of employment, if the occasion offers, and is only to be guarded against by competent knowledge and due vigilance in the employer. One of the first requisites is the keeping of accurate and methodical day accounts of all men so employed; and on the measuring of every new piece of work, to ascertain how much has been earned per day, and when that has much exceeded the ordinary day's pay of the country, let that experience operate in reducing the price of the next job to the common wages of competent and industrious men. See " Supplementary Note," No. 5, post.

A superannuated labourer, or *odd man*, too old for hard work, but still active enough for light employment, will be found useful for this purpose, and for many others about a farm of even moderate size; but in extensive concerns the assistance of a bailiff, or grieve, is indispensable; for, whatever may be the activity of the farmer, he cannot be everywhere, and every operation requires superintendence. It is not easy to find a competent person for this office: one who is master of his business, industrious, sober, trust-worthy, and sufficiently above the common labourers to command their respect: its duties, too, are laborious, for he must be the earliest and the latest, and his occupation is unceasing; but when such a man can be found he deserves encouragement This remark, indeed, applies to all the regular servants on a farm, with the addition of a qualification too commonly overlooked, and yet of much importance, especially in those entrusted with the management of cattle. The property under their care is often of considerable value, and a surly fellow, in a fit of ill humour, may do more injury to an animal than the amount of his year's wages would repay. *Good temper* is, therefore, not to be disregarded, and a servant who combines with it the other requisite qualities is invaluable. Economy does not consist so much in a parsimonious saving of wages, as in obtaining the full value for the sum paid: in all practical matters, not only diligence, but expertness and accuracy are of the greatest consequence; and it may be received as an axiom, ' that it is not merely the performance of anything, but the doing it well and properly, that ensures success.'

Whether we regard despatch or economy in farming concerns, nothing will be found to contribute so much to these, or to bettering the condition of the labourers, as *letting out* as much as possible of this irregular work at fair price, according to the degrees of labour and skill required in each species of work. Let the men be selected into small gangs, according to their abilities and industry, and always set the best gang about any new kind of work, or of that the price of which wants regulating, and encourage these by liberal prices at first, to be gradually lowered if necessary,—as when once masters of what is required, they may be mixed with inferior men.

On the discovery of any intended deception in the work at the time of measuring it, let more than its proportionate value be deducted, and let a separate job be given to one of the best gangs to alter and complete it; by which means shame is made to operate with loss of earnings, in favour of greater skill and honesty in future *.

* Farey's Derbyshire, vol. iii. p. 191.

CHAPTER VII.

ANIMAL LABOUR—HORSE TEAMS—FEEDING EXPENSES—LABOUR—MANAGEMENT—ASSES AND MULES.

Animal labour is an object of the deepest importance, both to the public and to those individuals who employ it: to the former, inasmuch as the amount of food thus consumed is so much abstracted from the general means of subsistence; and to the latter, as the value of its employment consists in the proportion of its cost to its power. It is, therefore, in every point of view, desirable to economize it, so far as may be consistent with its efficient use, both through the saving of the labour and the feeding of the cattle by which it is performed; but to these considerations must be added a due regard both to the effectual performance of the work, and to the sufficient support of the animal. Less has been done for the farmer than for the manufacturer, in the improvement of machinery, and unless the power of the steam-engine should at some future period be applied to the plough, he must still be dependent for the production of his crops upon the labour of cattle, which absorbs so large a portion of his profits, that he cannot be too careful of this branch of his expenditure. In this, however, as in the regulation of manual labour, true economy lies more in duly apportioning the strength of the teams to the work to be performed, than in any mere saving of expense; and there is no part of a farmer's business that demands a sounder exercise of judgment than the selection and management of his working stock.

It is usually considered that one team, if well kept, is sufficient for the cultivation of from 40 to 50 acres of heavy land, and from 50 to 60 acres of lighter soil, under common rotations; but the strength of that team depends so much upon the breed and condition of the animals, as well as upon soil and culture, that this is subject to much variation. Some tenacious clays cannot be worked with less than four strong horses, or even more, on breaking them up; while a free loam may generally be managed with a pair and whip-reins; and a course of constant tillage necessarily requires a greater number of ploughs than when a large portion of the land is allowed to rest for some years under grass *. Teams should never be below the work to be executed: every such apparent saving will turn out a real loss to those who attempt it, and even a supernumerary horse, for cases of emergency, will seldom be found bad economy. The great point is neither to be above nor below the mark: no example need be adduced to show, that if too little power be employed, the work must be imperfectly done; and that if too much, a portion of it must be thrown away. nor, although working-cattle should not be pampered, is it necessary to prove the truth of the old saying, 'if they won't pay for feeding, they won't pay for starving.'

REGARDING HORSE TEAMS,

It is a just observation, 'that one can hardly be at a loss to determine

* In the report of the Morvich and Culmaily farms (*Farmer's Series*, No. 18), consisting of 650 acres of arable land, it is stated that the whole work is performed by seven pairs of horses, including one pair of mares in foal, and one pair of young horses, thrown off to grass during summer: but the rotation on the greater part is,—1st turnips; 2d barley; 3d, 4th, and 5th, grass; and 6th oats; on the remainder, 1st rape and naked fallow; 2d wheat; 3d and 4th grass; and 5th oats; or nearly one-half in grass.

the character of a farmer from the condition of his horses *.' Very fine, high-fed cattle, exhibiting the appearance of being prepared for sale, rather suggest the idea of idleness than of labour; but, on the other hand, lean, spiritless creatures, worn out by toil and hunger, are the certain indications of a bad farmer; of one not thriving, and who does not deserve to thrive. The man who employs bad instruments cannot have his work well done, and one important and previous step towards good farming, is to keep the labouring stock in good condition. Horses regularly fed, and regularly wrought, will perform a great deal of work without falling off either in strength or appearance: it is, therefore, of great importance to distribute the labour as equally as possible through the various seasons of the year; and to take care that if, as must sometimes be the case, an extraordinary exertion is to be made, they are in the proper order to make it. When once allowed to fall off, it requires much more to restore them, than might have kept them in a good state.

The *feeding of farm horses* forms so material a part of the charges on agriculture, that the manner in which they can be cheapest maintained is a matter deserving the most serious attention. It is an established principle, that animal power can only be exerted in proportion to the quality, as well as the quantity, of the food with which it is sustained. In conformity with that rule, hay and oats, or beans, given in their natural state, were long considered as the only horse provender possessed of the requisite degree of nutriment, and in consequence of its cost, penurious farmers stinted their horses, or those of an opposite disposition, who 'indulge in the pride of teams,' were put to very great expense. Experience, however, has proved that substitutes may be used to a very considerable extent, without injury to the animal itself, or diminution of its strength; and that different modes of preparing its ordinary food may be adopted with advantage.

The vegetables most commonly resorted to as *substitutes for corn and hay*, are potatoes, turnips, carrots, parsnips, and mangel-wurzel, with straw, and the haulm of beans and peas. Among these the potato ranks foremost, both in quality and in being more commonly cultivated than either parsnips or carrots; but it is attended with the inconvenience of requiring to be boiled, or steamed, as its juice has been found prejudicial, and in some cases even fatal, to horses, when given raw, and both it and the yam, which has lately been much employed for the same purpose, are apt to ferment in the stomach, and occasion dangerous cholic, when used in a crude state. Of turnips, the Swedish is the only one that can be recommended to be given alone, though the common kinds may be advantageously mixed with potatoes; but, when given in that manner, they should be boiled separately, in order to preserve their juice, which if not given to the horses, will be found serviceable for store cattle and pigs. Carrots are much relished by all cattle, and when combined with dry food, have a most perceptible effect upon the horse's coat, soon imparting to it that glossy appearance which is one of the best tests of condition, and consequently of health: they are also thought to improve the wind. Parsnips are still more nourishing, horses eat them greedily, but they soon clog the appetite; and, in the island of Jersey, where the root is used extensively for other purposes, it is never given to them, for it is alleged that, when kept on that food, their eyes are apt to suffer injury †. Mangel-wurzel, though inferior to these, is preferable to any turnips, except

* E. Lothian Survey, p. 197.

† Quayle's Survey of the Islands on the Coast of Normandy, p. 103.

Swedes*. All these roots, except potatoes, and turnips when used along with them or other substances, as a mash, are generally given raw, and care should be taken, in slicing them, to cut the pieces sufficiently small to prevent them from sticking in the throat if swallowed whole; an accident from which serious consequences have ensued.

In most instances only one half of the usual allowance of corn has been given to horses thus fed, and they have notwithstanding gone through their customary labour with as much apparent ease, and have been maintained in as good condition as when kept in the ordinary way. In some cases, all the corn, and in others, all the hay, also, has been withheld, and numberless accounts have been published to prove that the work has still been equally well done. Some of these are subjoined, in order that every one may judge for himself of the degree of attention to which they are entitled It must, however, be remarked, that although farm-horses may be kept in very fair condition, and their common field-labour may be performed, at some seasons, without corn, yet that hard-work cannot be supported without high-feeding, of which sound hay and oats, and old beans or pease must ever form the chief part; though, even then, a portion of roots will be found serviceable in keeping the bowels open and the body in a healthy state. The following are a few of the statements most to be relied on.

In the details of management on separate farms, already published in the 'Farmer's Series,' we find that, in one instance, horses, constantly worked throughout the winter, as long as there is daylight, are maintained in good condition upon about a peck of oats, given in three feeds, chiefly of light corn, the last of which is made into a mash with yellow turnips, bran, and chaff, steamed or boiled together on the previous day: turnips are also given raw, and the only rack-meat appears to be oat-straw †. In another, only one feed of oats is given, together with hay and bean-haulm, and Swedes, both raw and steamed; and it seems that some farmers substitute Swedish and yellow turnips wholly for corn, yet their cattle are said to be fresh and in good working order: but it is admitted in both these instances, that when there is much carting, oats are allowed according to the work, and the quantity is increased in the spring ‡.

The late Mr. Curwen, who tried more experiments than most men in the feeding of cattle, kept nearly a hundred of his colliery and farm-horses during the winter upon equal quantities of *cut straw and potatoes*, steamed together, in lieu of hay; and found that some which were worked in the same manner, but fed with hay instead of potatoes, were not in equal condition with the others §. His mode of feeding, as detailed by the Carron company, who have adopted his plan, is thus:—'They have three tubs steaming at a time: two of potatoes, and one of chopped straw, chaff, or dusting-seeds; they empty one tub of potatoes into a large mash-tub, by way of bottom layer; then the tub of chopped straw, and last, the remaining tub of potatoes: the whole is wrought up and mixed with a large wooden pestle; and to this they add a small quantity of salt. A bucket is brought for each horse with his feed of corn (bruised oats) in the bottom, and his proportion of the mash is filled in above; when it is emptied

* Statements of the proportionate value of these and other articles of cattle food, will be found under their respective heads in future chapters.

† No. 16, p. 70.

‡ Ibid., p. 97. See also No. 12, p. 43.

N.B. One peck and a half of oats make four Scotch *lippies*, or feeds, as alluded to in these accounts; or one half more than the quantity usually considered as a feed in England.

§ Hints on the Economy of Feeding Stock, &c. &c. by J. C. Curwen, Esq. M.P.

into the manger, the corn is of course uppermost, and the horse-feeder puts his hand through to mix it*.' They feed warm. The quantity of food, and calculation of expense, are as follows:—

Farm-Horses.	s.	d.	*Colliery-Horses.*	s.	d.
1½ stone of potatoes, at 3d.	0	4½	8lbs. of hay and 8lbs. of straw cut together.	0	5½
7lbs. of cut straw 1d. and cutting 1d.	0	2	Cutting	0	1
Steaming	0	0¼	7lbs. of steamed potatoes	0	1½
7lbs. long straw	0	1	6lbs. of carrots	0	2½
8lbs. of oats	0	8	12lbs. of oats	1	0
	1	4	per horse, per day	1	10½

The potatoes are estimated at 50*s.* per ton, inclusive of the expense of steaming; oats at an average of about 3*s.* 4*d.* per bushel; hay at 2*l.* 12*s.* 6*d.*, and straw at 15*s.* 6*d.* per load, exclusive of the cost of cutting.

After several years experience of the comparative merits of steamed potatoes and straw, or hay, Mr. Curwen gave a decided preference to the former, both as regards the saving of expense, its effects upon the health of the animal, and its power of upholding their condition; but notwithstanding the apparent candour of his testimony, and its being corroborated by many similar statements †, it is well known that, when much exertion is required, both hay and corn become necessary.

In Essex, we have the authority of Messrs. Vancouver and Arthur Young, who separately surveyed the county, that working horses have been kept throughout the winter entirely on *steamed potatoes*, to every 300lbs. of which there was added half a pint of salt, and occasionally a small portion of sulphur; and that, 'fed in this manner, they performed with the greatest ease *all the common labour of the farm*, without either hay or oats ‡.' The difference of the expense of a team of five, during half a year—calculating the potatoes as worth 40*s.* per ton, and hay and oats respectively at 3*l.* the load, and 24*s.* per quarter, which nearly accords with the estimate of consumption in the survey, would stand thus:—

Potatoes.	£.	s.	d.	*Hay and Oats.*	£.	s.	d.
5 Horses 182 days, at 50lbs. each, 45,000lbs. §, or 18 tons, at 40*s.*	36	0	0	5 Horses 182 days, at 24lbs. each, hay, 21,840 lbs. or 10½ loads at £3	32	10	0
Washing and steaming at 2*d.* per 100lbs.	3	15	0	Ditto 26 Weeks, at 2 bushels each, oats 32½ quarters at 24*s.*	39	0	0
3 Bushels of salt at 2*s.*	0	6	0				
Sulphur	0	2	6				
	40	4	4		£71	10	0
Balance in favour of potatoes	31	5	8				

The cost would thus be a fraction more than 10½*d.* per day, and the saving about six guineas for each horse in the winter half year, if they could be kept in that manner so long; but this mode of feeding cannot be commenced before November, nor continued after February, for, notwith-

* Communications to the Board of Agriculture, vol. v. No. 10, p. 210.

† See the Farmer's Magazine, vol. xi. p. 334, and xiv. p. 229; and the Survey of Dumfriesshire, chap. xiv. p. 376. The latter account states the quantity given to be 42lbs. of potatoes and about 10lbs. of straw, without any oats, *except when the horses are employed on the road.*

‡ Young's Survey of Essex, vol. i. p. 309.

§ The cwt. of potatoes is usually calculated to weigh 126lbs. Then 126×20=2520×18=45360. V. Thaër calculates 1 cwt. of hay as equivalent to 3 bushels of potatoes: both, however, necessarily vary much in quality.

standing the assertion of the reporters, as well as of many other persons of veracity respecting the 'common labour of a farm,' during the depth of winter, it cannot be continued during the spring, upon land that is properly cultivated, without either an unusual number of horses, or an allowance of corn*. Upon this statement, it is also to be observed, that supposing the oats to weigh 35lbs. per bushel, the daily allowance would then be 34lbs. of hard meat, or 1*s.* 7*d.* per day, which is the highest estimate that can be admitted for a common-sized cart-horse, and would assuredly support him in better condition than any quantity of potatoes that he could consume. Were the allowances of corn and hay reduced in a fair proportion to the working value of the food, the cost would, therefore, be more equalized; but although experience may not justify the sanguine expectations of the advocates of leguminous plants, as horse-meat, to the full extent of their calculations, there can yet be no doubt that on light soils, and in situations which do not afford a market for field roots, they may be advantageously substituted for hay, and when the work is not severe, even for a considerable portion of corn.

Regarding *carrots*, we nave also the evidence in their favour of Mr. Curwen, who substituted them for a portion of the usual allowance of corn, and has adduced a certificate from his groom and farrier, that "when from 8lbs. to 12lbs. of oats are allowed to a work-horse per day, according to its employment, 4lbs. may be deducted for 5lbs. of carrots, and the spirit, condition, and ability of the horse to perform his work improved by the same †:" but the saving this effected amounted only to a shilling in the week. Other accounts state a bushel of carrots to be given daily instead of oats; and an Essex sportsman is mentioned, whose horses, thus fed, without any corn, follow a pack of harriers twice a week ‡.

In the Sandlings of Suffolk, horses are chiefly fed on carrots, with sometimes hay, and sometimes corn, and sometimes with only straw; viz.:—

6 horses, 2 loads of 40 bushels per week, no corn, and little hay

Do. 1 load, with corn in the spring-time, and little hay.

Do. 72 bushels per week; no oats, and half the usual allowance of hay.

The horses are said to be in superior condition than when fed on oats; but this probably arises from their being allowed as much as they will eat, while oats are allowanced §. In Surrey, also, where carrots are extensively cultivated, a team of four good horses gets about 60 bushels per week until Christmas, with plenty of sweet chaff, or clover hay, but no corn; and after that 40 bushels are given with 2 bushels of oats and a sufficiency of chaff ‖.

Common turnips scarcely merit notice as horse-food; but *Swedes* have been given in various instances, besides those already particularized, with evident advantage, both sliced in their raw state, and steamed; and as they are both more commonly cultivated and less expensive than most other roots, they are deserving of the superior attention of economists.

* A correspondent in the Farmer's Magazine, vol. ii. p. 217, recommends a mixture of 4lbs. of boiled potatoes and 4lbs. of bran, at each feed: adding, from six years' experience, that this method 'saved much corn, and gave his horses a very fine skin.' Were 2lbs. of ground oil-cake substituted for the bran, it would form a far heartier feed, without much difference of cost.

† Hints on the Economy of Feeding Stock, &c., p. 207.

‡ Berkshire Report, p. 228. Essex do., vol. ii., p. 5. In the communications to the Board of Agriculture, there is also an instance of farm-horses fully worked and fed entirely on carrots, instead of hay; but they get 70lbs. each, sliced, along with chaff.—Vol. vii., art. ii., part 1.

§ Suffolk Report, chap. vii., p. 125—140.

‖ Malcolm's Modern Husbandry of Surrey, Kent, and Sussex, p. 482.

STEAM.

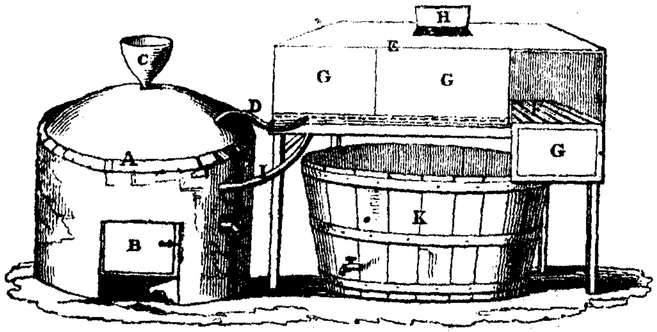
The chief value of boiling, or *steaming the food of animals*, seems to consist in rendering it more easy of digestion, and thus, perhaps, enabling them to retain a greater portion of its nutriment than when it is used in a crude state. For old horses especially, whose teeth being worn are incapable of effectually grinding the corn which their work may render necessary to their support, and whose powers of digestion are weakened by age, this is an incalculable advantage. Being softer than dry food, it is besides more readily consumed, and consequently allows more time for lying down and taking rest, a difference of more importance in its favour than may be generally imagined, for a horse takes from three to four hours to masticate a stone of hay, but a mash of potatoes of double that weight may be eaten in forty minutes. But for young and working cattle, in the full enjoyment of their health and strength, it may admit of doubt whether the constant use of such soft food may not weaken the powers of digestion, and relax the tone of their muscular fibre; for it has been found, from very careful trials, that, when only a small quantity of roots is given, the health and condition of the animals are improved by giving them in a raw state, as, in that form, they have a kindly effect upon the bowels; and, besides promoting the digestion of grain and straw, which they do in a remarkable manner, they impart to the animal an additional degree of life and spirit. In cases, however, where they have formed the chief article of food, boiling or steaming has been found to possess a more fattening quality, for it has the effect of depriving vegetables of a part of their watery juices, leaving only the farinaceous and other solid portions: thus potatoes lose about an eighth of their weight by the evaporation of water, when they are steamed, and about one-sixth if kiln-dried or baked, in which state they are, from the chemical change which they have undergone, more nutritious than when raw. There is, however, very essential difference in the quantity of nutritive matter obtained from various qualities of the potato; for although when dried, the fibrous, or solid, matter may be of equal weight, yet it has been shown by various experiments that the product of starch, which constitutes the most nutritious portion of their substance, varies from one-fifth to one-seventh of their product *.

The superiority of the method of fattening cattle with food thus prepared has been proved by many experiments; and it is even said, that some postmasters on the Western road having, in pursuance of a suggestion of the Bath Agricultural Society, boiled the oats for their horses, and given them the water to drink, have ascertained that a bushel given in that manner will maintain a horse in better condition than two in the common way†. So broad an assertion may well be received with hesitation: yet the experiment is worth a trial; and, if used with caution, and mixed with a certain quantity of dry food, there can be little doubt that steaming a portion of horse provender, whether mixed with roots or not, will be found an economical plan. Mr. Curwen recommends it to be given warm; and no one at all acquainted with stable management can be ignorant of the comfort of a warm mash to a horse after extraordinary fatigue; it also improves the appearance of the coat, and the seeming condition; but it is not natural to the animal; and, notwithstanding the experience of Mr. Curwen, it may yet be doubted whether, as a constant practice, it would not be too relaxing. At the utmost, the mere chill should be taken off.

* Sir Humphry Davy's Agricultural Chemistry, p. 128.
† Mechanic's Magazine, October, 1831.

The objections usually urged against steaming are, the expense, the trouble, and the difficulty of preparing the feeds for several teams. But an ordinary *steam-apparatus* may be put up for a mere trifle, and food enough for a dozen to twenty horses be got ready, with little difficulty, in a short space of time, and with a very moderate quantity of fuel. When the cattle are not sufficiently numerous to justify the erection of a steaming-shed, the copper commonly placed in the corner of every wash-house may be replaced by an iron boiler, and used for this purpose in the following manner.

In the top there are two holes, one for receiving a funnel to supply the boiler with water, and the other for admitting the neck of a leaden pipe, which conveys the vapour to the steamer; the funnel is furnished with a steam-tight plug, and the boiler should be kept about two-thirds full. Adjoining the boiler, a strongly rivetted box, of sufficient dimensions to contain the intended quantity of food, is placed upon a frame of equal height with the top of the boiler, from which the steam-pipe passes into it a few inches above the bottom, and just under a rack of laths, made strong enough to support the food, which is to be placed upon it, and close enough to prevent its falling through the intervals. The front of the box opens by either sliding or falling doors, sufficiently large to allow of the food being put in and taken out, and sufficiently tight to prevent the escape of the steam; and in the top there is a small but heavy trap-door, the weight of which keeps it down, unless the pressure of the steam be too great, in which case it is forced open, and allowing a portion of the steam to pass, thus acts as a safety-valve. The steam penetrates through the rack into the whole mass of materials in the box, and, when condensed, drains down again, as water, with the oozings of the vegetables, upon the bottom, from which it is conveyed away by a waste-pipe communicating with the boiler. In placing the food, care should be taken to put the roots at the bottom, and those articles which lie closer—such as hay, straw, bran, or chaff,—at the top, so as to allow a free passage upwards for the steam. A large basket may be placed underneath the box, into which the food may be raked when ready; or a tub, with a cock at the bottom, to let off water, may be used both for that purpose, and for washing the roots previously to their being steamed. The interior of the box may be divided by sliding partitions, reaching as far down as the rack, for the convenience of separating the different kinds of food, if that should be thought necessary: the steam-pipe may also be made to pass along its whole length, and being perforated with small holes, will thus distribute the vapour equally.



A, Boiler. C, Funnel. E, Steamer. G, Doors. I, Waste-pipe.
B, Furnace. D, Steam-pipes. F Rack. H, Trap. K, Receiving-tub.

There is no occasion for the box being so large as to prepare all that may be required at one time, as a very large portion of different materials may all be steamed within an hour. The annexed figure will fully explain the plan of the machine, the whole cost of which would probably not exceed ten pounds.

Another apparatus may be constructed by placing, adjoining the boiler, a bench long enough to admit of any requisite number of steamers standing in a row. These, which need only consist of strong iron-bound pails, with closely fitting, yet not quite steam-tight, lids, have each a loose false bottom riddled with holes, or a strong wire grating, let down into them, with a handle for the convenience of removal, and resting upon a ledge, or on pegs, about two inches above the real bottom. Upon this false bottom the roots are placed, with some chaff upon the top, for the purpose of more effectually confining the steam, which entering from below, and ascending through the upper part of the vessel, is there condensed and falls down through the grating into the space underneath, from which it is occasionally let off by a small plug-hole into a trough in front of the bench, which serves the same purpose as the tub under the steam-box.

A very little practice will show the time when the condensed steam should be allowed to run off, as well as that when the boiler should be replenished. The fire will also require attention, but need only be moderate, as it is both unnecessary for this purpose, and dangerous to generate a high pressure of steam.

A pail of 15 inches diameter at the top, 12 at the bottom, and 18 in depth, will contain from 30 to 40lbs. of chaff and roots, and it has been ascertained that this quantity may be sufficiently steamed in about half an hour: when ready it is lifted out with a false bottom, and the steamer again filled. Thus, supposing each pail to contain the food of one horse, by either of these simple contrivances, and with only three or four vessels, enough may be prepared for as many teams in little more than a couple of hours; or allowing time for washing, lighting the fire, and every preparation, within half a day's work of any girl or old person unfit for hard labour.

When less food is required, a large tub, or a cask, may be fixed over the copper, the bottom being merely perforated with holes, without any grating, and care being taken that it fit tightly into the boiler; or, should there be any difficulty in that, it may be obviated by spreading some wet clay round the bottom of the boiler, or by simply wrapping it with a doubled sack, to prevent the escape of the steam. The condensed steam will, in that case, partly supply the waste of the water in the boiler, and what may be further necessary can be supplied through a funnel and pipe passing through the cask *.

'The *furnace*, No. 1, of the following dimensions, will also prepare a large quantity; and the figure, No. 2 in the following cut, displays a *cylindrical open box*, in which potatoes or sliced roots are washed with great facility. The trough of the latter, which contains the water, is about 3½ feet in length, by 15 inches deep, and 2 feet in width. The ends of the cylinder are solid, but the other part is formed of spars about an inch wide, and almost as much apart; it opens with a small lid of the same materials, for putting potatoes in and out, and, on turning them half a dozen times round, they will be found washed quite clean.

* See also the Farmer's Series in the 'Library of Useful Knowledge.' 'Farming at Scoreby'—No. 25, p. 19; and the engraving of Mr. Liddell's machine, in the second volume of the Transactions of the Highland Society, *New Series*, p. 321.

Fig. 1.

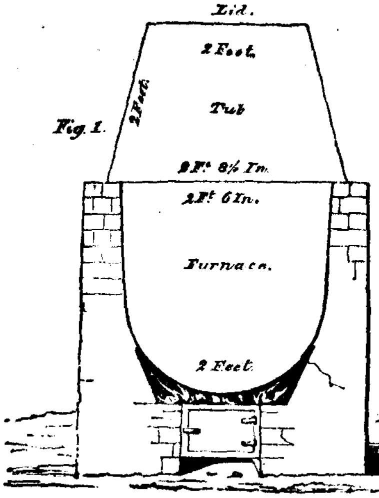
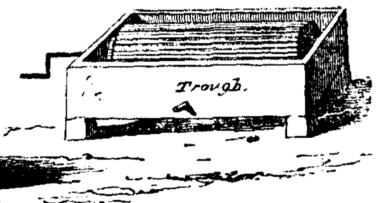


Fig. 2



FODDER.

Notwithstanding the numberless experiments which have been lately made on almost every kind of cattle food, and the extensive use of *straw as fodder*, it is remarkable, that no accurate account has yet been published of the relative properties of the different species. Those writers who have treated the subject the most scientifically yet vary in their estimation of its qualities*, and these are subject to many gradations, according to the soil and season, as well as to the nature of the grain by which it is produced. It is thought that, when grown on gravelly or rich clay soils, it is more valuable as fodder than when it is reared on black deep loam or cold moorish land; and it is now generally admitted that it possesses more succulence when the corn is rather green than when it is in a riper state. It is supposed by many that the straw of wheat is the most nutritive; it certainly makes the strongest manure, and is thought to be the best for either steaming or cutting into chaff. Although that of oats is usually preferred, as more soft and more palatable to cattle, that of barley is so poor and brittle, that it is only employed as litter: it is extremely difficult to save it in any tolerable degree of order; and, though it has been said to possess more nutriment than that of wheat, yet, when the crop is fully ripe, the ears break off in handling, which has been contended as sufficient proof that it contains but very little sap†. Rye-straw is so scarce in all except the northern counties and some parts of Wales, and is in such demand for thatching, brickmaking, &c., that it is but seldom applied to other uses.

When not allowed to be carried off the premises, the chief value of white straw, for farm purposes, lies in its conversion into manure—for although it may carry store-cattle through the winter, it will neither fatten them nor enable any animal to work—and its intrinsic worth, for the uses of litter and of occasional feeding, has been estimated by experienced farmers as high as 30*s*. the ton‡; but that calculation was made at a time when all farm pro-

* Professor Von Thaër, Principes Raisonnés d'Agriculture. Annales de l'Agriculture Françaises.

† Scottish Husbandry, p. 378—386.

‡ Sir John Sinclair: Scottish Husbandry, 2nd Ed., p. 880. Brown of Markle, Treatise on Rural Affairs, vol. i. chap. v.

duce, and consequently manure, was higher than at present, and it may now be reduced to 20*s*. Weight for weight, there is a material difference between that and the common price of hay; but as the same quantity cannot be substituted for hay, either its own proportionate increase of quantity, or the value of any other food given to make up the deficiency, must be added in order to ascertain the saving: thus, supposing 24lbs. of hay, at 3*l*. per load, to be the daily allowance of a horse, and this to be replaced by 24lbs. of straw, and 28lbs. of Swedish turnips, the latter valued at 6*s*. 8*d*. per ton, or 4*d*. per cwt. *, the difference excluding fractions would be

	d.		*d.*	
24lbs. of hay, or	8½	24lbs. of straw . .	2½	or 9*s*. 4*d*. to 10*s*. 6*d*. per week on a team of four.
	—	28 „ turnips . .	1	
		drawing and slicing .	½	
		(if steamed) . . .	½	
Saving per horse per day		. . . .	4	
			—	
			8½	

Whenever straw is used, weight for weight, instead of hay, their relative value, *per load*, may be estimated according to the following scale :—

	lbs.		
Hay 36 Trusses, 56lbs. each †	= 2016	Hay at 45*s*. =	Straw at 28*s*. 6*d*.
Straw do. 36lbs do.	= 1296	„ 60*s*. =	„ 38*s*.
		„ 72*s*. =	„ 45*s*. 7*d*.
		„ 84*s*. =	„ 53*s*. 2*d*.

From which calculation it results that, even when the sale of straw is permitted, it may be economically substituted for hay, during the winter months, for the customary market load of wheat-straw seldom fetches more, even in great city markets, than 36*s*., which, deducting the expenses of binding and carriage, will not, in most places, leave so much as the above sum net ‡.

The *haulm of beans and peas*, but especially the latter, when well harvested, forms a very hearty species of fodder. The stalk of the beans, indeed, is tough and somewhat woody, and is therefore commonly thrown out as farm-yard litter; but the coving chaff is very good manger-meat, and even the stalk, if bruised and cut and then steamed, would be found useful in a farm-stable.

Pea-haulm is very generally employed as rack-meat, for which purpose it is well adapted, being succulent and nutritious, and nearly as much relished by cattle as hay, and although it may not go quite so far, there is yet a great saving in its use. But both these, and all other kinds of straw and haulm, should be given as fresh as possible from the flail, for they grow brittle, and lose a portion of whatever sap they possess by exposure to the air: if long kept, they grow musty, and in that state neither are wholesome nor will be eaten by horses. Pea-haulm should be given cautiously, as it is flatulent and apt to occasion colic: it is also said to be productive of botts; but that, if true, is not so peculiar a property as to prevent its use.

* The value of the turnips is calculated on the supposition that the acre produces 15 tons *of roots*, exclusive of tops and tails, worth 5*l*. per acre on the ground. The quantity is too high for some soils, and some modes of cultivation, especially in the southern counties of England; in others, it is too low, but, as an average, it comes near the truth, and each farmer may make his own calculation according to the produce of his land.

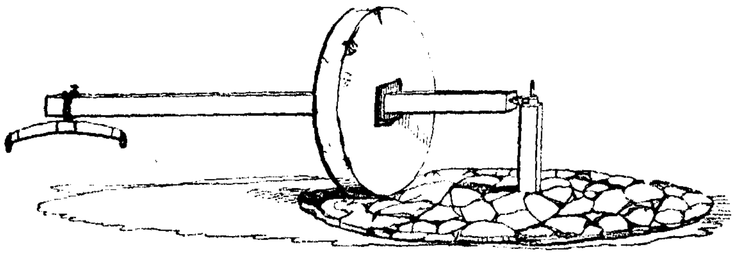
† N.B.—The market weight of the truss of *new hay*, is 60lbs., until the 4th of September.

‡ Mr. Middleton calculates the expense of binding and marketing straw, within eight to ten miles of London, at 15*s*. 6*d*. per load; viz. binding 1*s*., two horses, cart, and driver 11*s*. 6*d*., toll-gates 1*s*., beer, market, and salesman's charges 2*s*., which, allowing 5*s*. 6*d*. for back carriage of dung, would reduce the net pric to 26*s*. per load. —*Survey of Middlesex*, 2d Edit. sect. iv. p. 222.

The *straw of canary-seed* is also an excellent fodder; but the cultivation of the grain is too limited to render it an object of general notice.

Among other substitutes for hay, of only limited application, the *whin* or *furze* seems well entitled to the attention of farmers dwelling in the vicinity of wastes on which it grows spontaneously, and can be procured without any other expense than that of cutting and bruising. From an account published by Mr. Tytler, of Balmain, in the fifth volume of the Transactions of the Highland Society, it appears that he had during five years consecutively fed his farm-horses, from the beginning of November to the middle of March, on furze and straw, with a very moderate allowance of oats during only a part of that time. At first, oats were given throughout the winter, but afterwards only from the beginning of February, and then only at the rate of 3lbs. 2oz., or about one-third of a peck of average quality to each: the daily allowance of furze during the former period being 28lbs., and 18lbs. during the latter, with 14lbs. of straw.

The cutting and preparation of the whins are performed by a woman with the occasional assistance of a boy, a cart drawn by a mule, and a bruising-mill. The woman being provided with a pair of stout hedge-gloves, a sheep-skin apron, a reaping-hook, and a forked stick, draws the plants towards her with the fork, and cuts off such parts only as constitute the succulent shoots of the year's growth, which, being laid in bundles, are compressed into faggots by a stroke of the foot, and in this manner she cuts sufficient for a dozen horses at their fullest feed, in six or seven hours. The boy and cart then fetch the load; and on its arrival at the farm-yard, the mule is yoked to the bruising-mill, which merely consists of an old mill-stone mounted on a horizontal axle, 12 feet in length, one end of which is attached to an upright post by a pin on which it revolves as a centre, round a circular course of eight feet diameter, paved with common flag-stones; to the other end a swingle-tree is hung for the mule, thus:—



The whins are spread round the course, and turned over with a fork until they are thoroughly crushed, which occupies about three hours. The whole cost of this very simple machine does not exceed 5*l.*: it might be drawn by a donkey, and rendered useful in bruising beans, or breaking rape-cake, and for many other purposes.

The expense of feeding eight horses, in this manner, is calculated by Mr. Tytler, as follows:—

	To Feb.	From Feb.
Woman's wages	0 6*d.*	0 4*d.*
Part wages of boy	0 4	0 3
Part keep of mule	0 4	0 3
1 cwt. straw	2 0	2 0
25 lbs. Oats	0 0	2 6
	3 2	5 4
Equal, per horse, per day to	0 4¾	0 8

The work of these horses was the same as that of other Berwickshire farm-teams, which is by no means light, and Mr. Tytler says, 'they not only kept, but improved their condition, during the whole season; but began to show a distaste to the whins, about the commencement of spring.' The practice, indeed, is not new: the forage of the regimental horses of the British army under the Duke of Wellington, while in the Pyrenees, was chiefly furze, which is commonly used for that purpose on the frontiers of France and Spain; it has also been often recommended in this country, but never in such detail as by this gentleman *; and, though not much employed in midland places, it is yet much used in many parts of Wales, and in several of the Irish counties †.

An acre of whins has been found sufficient for six horses during four months, and they require two years to produce them. It has been found that horses, with *one feed of corn* and whins, were in as good order as with two feeds and straw: so that the whole of the straw, and one feed of oats, were thus saved, and valuing these at *seven-pence a-day each horse*, the saving, in seventeen weeks, amounted on the six horses to 17*l.* 17*s.* from which deduct 5*s.* a week, as the expense of cutting and bruising, there would remain 13*l.* 12*s.* as the product of two acres, or 6*l.* 16*s.* per acre, yearly ‡.

PROPORTION OF DRY FOOD.

The most nourishing food given to horses consists of corn; and *oats* are commonly considered as the best adapted to their constitution; but when any other species of grain is furnished in like proportion of weight, the nicest observers have not been able to discover any apparent difference in its qualities, provided it be mixed with a proportionate quantity of straw, chopped fine, or of bran, to supply the place of the husk of the oats, without which other corn should not be given. Horses, when not pressed by hunger, often try to separate this chaff, or bran, from the grain, and it is therefore customary to sprinkle it with water; but in that case the greatest care should be taken to thoroughly cleanse the manger, for nothing is more noxious to horses than food thus wetted and allowed to become stale. Grain of every description ought to be free from the natural fermentation which it undergoes if not in a perfectly dry state. Oats harvested in a wet season have been known to occasion epidemical disorders among cattle, and farmers frequently do serious injury to their horses by supplying them with it soon after it has been reaped. Corn that has sprouted is not unwholesome, provided it has not imbibed a bad smell from having been heated; and malt, or barley which has been only slightly steeped for two or three days, though without being dry-malted, is considered particularly nutritive. It is thought, indeed, that the completion of the process adds much to its invigorating properties, and it is often used in that shape on the continent, though not in a larger proportion than one-third of other grain §; but, even if it has that effect, the duty on malt prevents its consumption by cattle in this country, and it cannot even be purposely wetted without incurring the suspicion of the excise. Many horses, also, which eat voraciously, are in the habit of bolting their food

* See the Annals of Agriculture, vol. xxxv. p. 13—17; Encyclop. Brit., art. Agriculture; Farmer's Mag., vol. xx. p. 282; Comp. Grazier, 5th Edit., p. 559; and Quarterly Journ. of Agric., No. XI.

† Surveys of N. Wales, p. 342; of Cork, p. 248; of Wicklow, p. 282; of Galway, p. 86.

‡ Mid Lothian Report, Appendix, No. VI., p. 56.

§ Von Thaër, Principes Raisonnés d'Agriculture, vol. iv. p. 695.

without chewing it; in which case their oats should never be given without being either mixed with chaff, or else bruised by cylinders, such as are used in bruising or grinding malt.

Beans, and latterly *peas*, are also largely given to farm-horses, without any prejudicial effect; and, if care be taken not to supply them in summer, at which season they are found to be too heating, no bad effect will be found to arise from their use: but, as they contain an unusual proportion of sap, they should be at least twelve months old: if they shrink in quantity, it will be made up in quality.

When horses are fed on *hay*, it is matter of dispute whether the light and apparently arid grass of uplands, or that of more fertile natural meadow ground, or the rich produce of the artificial grasses, is to be preferred. This must however depend on the quantity of corn with which they are supplied. When that is abundantly furnished, there can be no doubt that the former will be found better for their general health, and especially for their wind; but as farm-horses are generally limited in their consumption of grain, and the slowness of their movement renders the clearness of their wind a matter of comparatively little moment, the other kinds will be found the most substantial, and consequently the best adapted to support their strength.

There can be no doubt that the feeding of horses upon hay, in whatever quantity it may be supplied, can never be entirely substituted with equal effect for corn; but opinions are also divided respecting the proportion in which it may be furnished, both with regard to health and economy. On this, however, no general rule can be laid down, for it must not only depend upon the animal's constitution, but also on the work which he has to support. It has, however, been calculated, by a foreign writer of great experience *, that ordinarily 8lbs. of meadow-hay are equal in nourishment to 3lbs. of oats: 7lbs., however, of sainfoin, tares, clover, or other succulent hay, are supposed equal to the same quantity, though sainfoin is perhaps entitled to the preference; but 9lbs. are thought to be required from hay made of poor pasture. The longer too, within a certain time, that hay is allowed to stand in the stack, the better it is, and perhaps that which is a year old is the most wholesome for horses: the second growth is not equally nourishing. It should also be got into the stack as soon as properly dried, in order to preserve the freshness of its scent, which is peculiarly gratifying to cattle.

In general, however, it is to be observed that, when the quantity of hay is augmented with a view to the diminution of the corn, although horses will thereby acquire more fat than upon the same proportion of grain, yet they are less equal to the efforts of hard work; whereas, if the corn be increased and the hay diminished, though the cattle may appear to grow thin, yet their flesh is more firm, they are capable of greater exertion, and are in what is usually termed 'better condition.'

SOILING.

With respect to the advantages of *soiling horses on green food*, in the yard or stable, it seems to be now generally understood that, with proper management, they can be supported with great health and vigour: its economy, however, must depend on the proportion which it bears to the price

* Professor Von Thaër, of the Royal Farm and College of Agriculture, established by the King of Prussia, at Moëgelin, near Francfort upon the Oder. The translator of his work—the Baron de Crud—calculates that a horse consumes one-eighth less of meadow-hay than of that made from the artificial grasses.—Vol. 1. p. 162, note.

of dry food, and its convenience to the quantity in which it can be spared for other cattle

It is a very old, though by no means a universal practice*, and the experience of hundreds of farmers proves, that horses maintained in that manner for years have neither lost flesh nor strength sufficient for all farming purposes, although there was no palpable saving of their work, and that, though afterwards placed on dry food during the winter, they continued in perfect health. It is an excellent plan to give some green food along with the corn and chaff, before the usual period of feeding entirely on dry fodder: the change from dry to green, and again from green to dry food, should be gradual. In its commencement, the clover or tares should be cut, and mixed in small portions with straw, and a proportionate quantity of corn should be reduced. The green food is then insensibly increased, until the corn is entirely omitted, and the quantity of green meat is supplied without limitation: it should, however, be cut over-night, and given only in small quantities gradually increased, to guard as much as possible from accidents, which may arise from its succulence by hoving. When horses are soiled, they never should get much at a time, a practice far too prevalent among servants.

The *summer feeding of horses* was formerly confined to pasturage; but of late years the practice of soiling has become very general. The benefit of grazing consists in its requiring little attendance; and being the most natural, and therefore the most healthful, it is preferable for all young cattle which can be spared from constant labour, and on farms which contain a considerable portion of rough pasture. But for horses at regular work, these advantages are counterbalanced by the time lost in getting them up from the field; the indisposition to labour which they acquire by being at large; and the annoyance which they suffer from heat and flies when turned out in the day-time. The value of their dung and urine is also in a great measure destroyed by being scattered upon the surface of the ground, and exposed to exhalation of the sun and wind; and there is much waste of grass, and injury done to the mellowness of the soil, if it be valuable land, by the treading of all heavy stock, but especially of horses. The utility of soiling consists in a more economical consumption of grass, whether natural or artificial, than by grazing; in the accumulation of manure, and in the quiet and coolness which the cattle enjoy under sheds, or in the stable, during mid-day, as well as in their being always ready when wanted: the only disadvantage is the expense of cutting and carrying home the grass, against which may be fairly set the increase of manure, if expense be really incurred; but as, during summer, there is usually a long interval of rest between the morning and afternoon work, the carters can then cut the necessary quantity, which may be drawn to the homestead by one of the team-horses, if there should not be a supernumerary one left for odd jobs.

When, however, the economy of the practice is not the chief consideration, horses on summer work may be *both grazed out and soiled.* They may be put on cut clover in the middle of the day, between yokings, and turned out during the night into a well-sheltered meadow or enclosure. In being kept under cover during the heat of the day, they will be sheltered from flies, and will feed more at ease; and in being pastured out during the night, they will also have an opportunity of selecting those grasses which act as condiments and are most agreeable to their palate. All ani-

* It is mentioned in a treatise on Agriculture, entitled 'Hartlib's Legacy,' so long ago as 1650, p. 245.

mals like variety of grasses, selecting always what is most palatable, which they cannot do when soiled, particularly if fed on cut clover or tares. Exposure to the night air is also found to be highly favourable both to their health and appearance

The economy of soiling, wherever it can be conveniently adopted, is, indeed, too generally admitted to need the support of argument; and particularly on soils on which turnips are entirely consumed on the ground, or on which they cannot be grown, and where consequently there is difficulty in converting the straw into manure during the winter, it cannot be too strongly recommended. But it requires a succession of green crops; and as only the artificial grasses are resorted to in England—though in many parts of the continent the meadows are also mown for that purpose—it is necessary that winter and summer tares should be sown at different periods, so as to afford a constant supply, both before clover comes in, and after the first crop is off. This is a great impediment to the practice in Scotland, and in some of our northern counties, where tares are an uncertain crop; though cattle are certainly soiled with great advantage, both there and in other places, on clover alone. In other situations too, farms, on strong clay, frequently contain a large portion of meadow, and grazing being combined with tillage, the whole of the straw is consumed in the winter; in which case one of the chief advantages of summer soiling would be lost, as yard dung, without the addition of straw, is of very little value. But even in this instance, or in others where the distance of the fields from the homestead may be opposed to the cartage of the grass, it is better to cut it daily, and give it on the ground in pens, or small inclosures hurdled off, so as to prevent the cattle from injuring the growing crop, than to allow them to range over and trample it. By confining them in this manner to a small space, and moving the hurdles forward as the grass is eaten, the fertilizing properties of the dung and urine, which would otherwise be lost, are in a considerable degree preserved; and if the land be immediately ploughed, it will be nearly as much benefited as if it were more regularly manured

The artificial grasses used for soiling are the same as those already enumerated as hay, but here *tares* take the lead, both because the winter species is earlier ready than any other, except rye-grass, and affords a weightier crop. In most seasons, tares are ready for the scythe towards the middle of May, for if left till they are quite ripe they will become unfit for soiling before the crop can be used; and although there may be some loss in using them so soon, it will be compensated by the saving at the latter end, as well as by commencing the soiling sooner than would be otherwise practicable. Before they are off, clover will be ready; the tares still standing may then be made into hay, and by the time the clover is becoming strawy, and losing its succulence, spring-tares will come in, which, if they have been sown at intervals of about a fortnight each, will last until the second cut of clover: or, if spring-tares be not sown, the growth of part of the clover may be checked by light early feeding. There is also an excellent fashion regarding soiling in Dorsetshire, which consists in saving a portion of rye alone, to be cut green; then another portion of rye, with tares; and afterwards the remainder entirely with tares: the rye comes first into use, and assists in raising the earlier tares, while those of later growth do not require any such nursing. Thus horses may be kept upon a succession of green herbage, without touching the meadows, throughout four months of the summer and autumn, and, while thus fed, require very little corn; when stirring the fallows, and during the hurry

of harvest, a couple of feeds a-day may be serviceable, but more is unnecessary, and at other times should be wholly omitted.

The mention of *lucerne* has been omitted, although extremely valuable for soiling, because it requires a peculiar quality of land, and is not commonly cultivated. In the Essex Report, it is said, that two horses have been supported during four months upon a quarter of an acre, with scarcely anything given to them besides; and that six horses, at hard work, have been kept on lucerne, instead of hay, but with an allowance of oats and chaff for twelve weeks—six from the first cut; four from the second; and two from the third: which, valuing the hay saved at 3*s*. per horse per week, would amount to 10*l*. 16*s*.* A paper in the communications to the Board of Agriculture also states that, in one year, twenty-three horses have been kept twenty weeks, and in the next, twenty-eight horses during eighteen weeks, upon eleven acres alone; which gives an average of three roods per horse in nineteen weeks†. It is also extensively used on the coast of Normandy, and in the neighbouring islands of Guernsey and Jersey; but it is there said that horses, particularly those used for the saddle, require more precaution from overworking, when first going out of the stable, than when fed on other hay; and, what is singular, that, when soiled on green lucerne, there is not the same danger ‡.

In Holland and Flanders, where the feeding of cattle is supposed to be better understood than in most places, the summer soiling of farm-horses is limited to half an acre of meadow grass, cut and carried to the stables, from the middle of May to the middle of June; from which time to the end of August one-sixth of an acre of clover is added, with 2lbs. daily of beans; and from thence to November, when the winter feeding commences, the clover is replaced by an equal quantity of carrots. From the number of horses stated, in this instance, to be kept in proportion to the tillage—11 to 150 acres, of alluvial soil—their labour can, however, be only light; though a pair is said to draw a ton and a half of manure in the field, and three tons upon pavement §.

Accounts have been also published, showing that horses may be regularly worked throughout the summer, in this country, without any corn: thus green crops, consumed by soiling, are said to go four times as far as when grazed; and that, in this manner, one acre of clover is equal to six of meadow pasture. But many of these statements rest only upon opinion, or upon insufficient data, and in all, so much depends upon the state of the crop, the size and health of the animal, and the work performed, of which the account is generally imperfect, that no safe conclusion can be drawn from them: it is therefore unnecessary to refer to them; nor is the cause which they are meant to promote assisted by being advocated upon any other than its real merits. A medium-sized farm-horse, at customary labour, consumes from 84lbs. to one cwt. of green food daily, with an occasional allowance of corn. Now a good acre of tares, or of broad clover, will weigh twelve tons, (that is, presuming the tares to be cut only once, and the clover twice ||; for although winter tares may be cut again, it is more

* Young's Survey of Essex, vol. ii. pp. 71, 72. † Vol. vii. Art. 25. Part I.

‡ Quayle's Survey of the Islands on the Coast of Normandy, p. 117.

§ Radcliff's Report of the Agriculture of East and West Flanders, p. 216. Another farm, of 200 acres, mentioned in the same Report, is cultivated by eight horses, each of which get daily, in winter, 15lbs. of hay, 10lbs. of straw, and 8lbs of oats; and, *after* every feed, a bucket of water, 'richly whitened with rye or oatmeal:' in summer, clover is substituted for hay, but the other feeding remains the same, and the '*white water*' is never omitted.—p. 54.

|| From an experiment made at Woburn, the green weight of an acre of broad

usual to get them off the land as soon as possible, either in order to sow turnips, or to form a bastard fallow;) and, taking that weight as the average of both, and the consumption at the highest rate, half an acre of either would support a horse during four months. This nearly accords with some instances in the county surveys; in others, more have been consumed, and, for the reasons already stated, it is next to impossible that any two accounts should agree; but, upon a rough estimate, it may be affirmed, that about a perch per day will be required for each horse in most seasons, and on most kinds of lands, if soiled, and that double that quantity will be necessary if pastured *.

It must, however, be borne in mind that the difference in the degree of succulence contained in various grasses must necessarily have a material influence on the state of the cattle by which they are consumed. Of this farmers are generally pretty well informed, either through their own observation, or by the experience of others; but an accurate acquaintance with the subject was not attained until the experiments made at Woburn, by which Mr. Sinclair has been enabled to ascertain the quantity of soluble nutritive matter afforded by all those grasses which constitute the produce of the richest ancient pastures, as well as those of artificial growth, and which will be fully adverted to in a future portion of this work.

The custom of giving corn along with green meat is unprofitable; for the grain, thus mixed, passes rapidly off the stomach, and is never perfectly digested. When, however, increased exertion demands an addition of more substantial food, and that corn is also allowed, it should be given only in the morning and at night, accompanied with a sufficient quantity of chaff to afford it consistence, and green meat should only be given at mid-day. Farmers very generally omit that precaution, and it is a common custom among them to allow half the usual quantity of corn, without regard to the effect of the watery juices of grass upon the digestion; but they may be assured that a great portion of the nutriment contained in the grain is thus wasted.

WINTER FOOD.

It cannot be doubted that working horses can be supported during the autumn and winter, until the growth of the young grasses, with only roots and hay, and plenty of hay and straw, without giving them any corn. But, although they can be maintained in perfect health and apparent vigour, yet they will be incapable of any strong or unusual exertion. Perhaps the most wholesome root, and that most relished by them, is raw carrots, without the tops, and then coarsely washed and sliced. Although, as we have already seen, potatoes have been advantageously used, yet it must be admitted that they are thought to occasion a certain want of spirit and flabbiness of flesh, which probably arises from the use of boiled food. It is

clover was found to be 49,005lbs. : =21 tons. 17 cwt. 2 quars. 5lbs.; but the soil is described as a rich clayey loam, and the crop cannot be assumed as an average. See *Sinclair's Hortus Gramineus Woburnensis*; and the *Appendix to Sir H. Davy's Elements of Agricultural Chemistry*.

* In one instance it is stated, that twenty horses have been supported for three months on six acres of tares (*Rutlandshire Report*, p. 71); and in another, that fifty-one heads of cattle—cows, oxen, and horses—were kept, during that period, on 15½ acres of mixed herbage; or, in each, about half a perch per day. (*Comm. to the Board of Agriculture*, vol. vii. part 1, art. 1.) A third mentions, that twelve horses and five cows, which, together may be considered equal to eighteen horses, consumed, in the same time, eight acres of tares, or 3 quarters and $\frac{1}{18}$ of a perch each daily (*Middlesex Report*, p. 257); and a fourth states the allowance of *pastured tares* (for twelve horses) to be an acre per week, or nearly two perch each day. (*Essex Report*, vol. ii. p. 354.)

also well known that, in many other cases, animals have refused even to taste them. This, however, has probably arisen from some want of care in the preparation—for, if boiled too soft, or in a mashed or wet state, they will not be eaten by horses: they should therefore be always steamed, and daily fresh dressed, nor should any other than the floury sorts be chosen. There is also some management requisite in getting horses to change their taste for any kind of food with which they are unacquainted: thus, a new species of root should be given in a small quantity by hand, when there is nothing else to eat, and apparently to coax them: when they relish that, a portion may be mixed with their other food, and in that manner they will be induced to overcome their dislike.

The *cavalry allowance* of hay and oats to horses in barracks, is 12lbs. of the former, and 10lbs. of the latter, on which they are kept in high condition; but it has been ascertained by experience, that a common cart-horse cannot be supported in good working order on less than 28 or 30lbs. of the same food, or more, if straw be substituted for any portion of the hay, supposing him to be of a medium size, and only employed on the customary farm labour; when greater exertion is required even that is insufficient. In some of the brewers' and coal-merchants' stables in the metropolis, the common allowance amounts to 36lbs. of dry food daily; and in those of Messrs. Wiggins, the great cart-horse contractors, it varies from 36lbs. to 40lbs., according to size and work, in the proportion of 16lbs. of clover or sainfoin hay, and 4lbs. of straw, to 18lbs. of grain, consisting of oats or barley, beans or pease, and 2lbs. of bran. The corn being given by weight, no difference is made in the amount of the allowance whatever kind may be used, and the choice depends more on price than on any settled rule; except that oats are preferred to beans in summer, and that rather more bran is allowed with the latter. Salt is not given regularly; but much benefit has been derived from the occasional use of carrots and Swedish turnips sliced along with the chaff.

The whole of this food is given as *manger-meat*, no part of it being put into the rack. The hay and straw are cut very short; the beans are bruised, and the oats sometimes coarsely ground; but it is found most advantageous to wet the barley, and allow it two or three days to sprout. The chaff is cut by a horse-mill, which at the same time bruises the beans by a small addition of machinery, and one horse with a couple of lads, one to unbind and deliver the hay, and the other to fill the trough, will cut a load of hay in three hours. The machinery, which consists of nothing more than a common chaff-cutter, of somewhat larger size than those used by hand, and a bruising apparatus of very easy construction—both of which may be readily added to a threshing-mill—works in a loft above the horse-course, on the floor of which the whole provender is afterwards mixed: the chaff being spread first, next the bruised corn, and lastly the bran, the whole is united in one mass; and having been separately weighed, is then measured off in distinct portions.

The horses, thus fed, are, however, of the largest size, and being used for drawing very heavy weights, consequently require more sustenance than the common run of farm cattle, for which the amount of dry food already stated—28lbs. to 30lbs. will generally be found sufficient. Taking the latter quantity, a suggestion published in the 'Sporting Magazine,' and recommended to the attention of farmers, is deserving of notice, as furnishing some useful hints, founded upon long experience of an eminent medical gentleman, in feeding light draught horses, which undergo very considerable fatigue in constant journies, at a rapid pace, and yet, on that

allowance, are kept in perfect working order. The ingredients of the food are divided into four classes, containing different quantities of each, to be used as discretion or convenience may dictate, in the following proportions:—

	1st.	2d.	3d.	4th.
	lbs.	lbs.	lbs.	lbs.
Bruised ,or ground beans, pease, or white corn	5	5	10	5
Hay, cut into chaff	7	8	10	8
Straw, do.	7	10	10	8
Steamed potatoes	5	5	—	—
Malt-dust, or ground oil-cake	—	2	—	2
Brewers' grains	6	—	—	—
Bran	—	—	—	7
And 2 ozs. of salt to each *	30	30	30	30

The weight of each class is 30lbs., and the quantity of nutritive matter contained in their ingredients is supposed to be equal. The first and second classes, of which potatoes form a part, are however preferred by Dr. Sully, though the grains and the oil-cake with which they are combined do not appear to form an adequate substitute for the difference made in the allowance of corn. Of *grains*, it may also be observed, that their too frequent or copious use has been found so injurious to horses, that those of brewers, when so fed, are said to become rotten and die in a few years; and on dissection are found to have large stony concretions in their bladders †.

As to the *salt*, the propriety of its *daily use* is open to question. That it contributes to the health of animals, is a fact too well established to admit of doubt; but the manner in which it acts upon their constitution—whether by merely aiding digestion, or by cooling and correcting the impurities of the blood—has not been sufficiently ascertained to fix with certainty either the mode, or the amount of its application. Numberless experiments on this subject have, indeed, been recorded, all tending to prove that it is relished by cattle, and improves their condition; yet, still the quantity to be administered to each, the time when it should be given, and its precise effects, remain to be determined, and can only be defined by more accurate trials than have been yet made In this, however, as in all matters regarding the treatment of animals, nature, when she can be consulted, is ever the surest guide. The tastes with which she furnishes her creatures, instinctively direct them to those kinds of food which are the most nutritive and the most healthful; but, although most animals in a wild state evince a taste for salt, it yet is only occasionally, and not regularly, indulged. The 'salt-licks' of America, which are masses of mineral salt, so named because they are licked by the beasts of the forest, afford abundant evidence in the excavations which have been thus made, that salt is essential to animal health: the elk, the deer, and the buffalo, traverse immeasurable wilds in search of them, and tracks are found leading directly to them from the remotest pastures. But the instinct which leads those animals to seek the 'licks' and 'salt-springs,' in which they are even said to bathe, is only periodical; the impulse once obeyed, they retire to their usual haunts, nor return until the recurrence of the same season. This, singly, would go far to show that salt is only useful as a preventive of disease, and should be only occasionally administered in large doses; but there are so many other well-attested instances of animals which thrive upon the constant use of saline plants, and of water impregnated with salt, that it

* Letter from Dr. Sully, of Wiveliscombe.—*Sport. Mag.*, vol. xix. p. 5.
† Middlesex Report, 2d Ed. p. 469.

cannot be considered as amounting to proof. That it is not hurtful when given moderately, in any way, is certain: but whether it should be employed in small quantities daily, or to the extent of half a pound at a time, for horses, and only once a week, or whether the practice should be confined to summer, is not so clear: perhaps a better mode than either would be to place a lump of rock-salt in a corner of the manger, and allow the horse, after having made him acquainted with its taste, to use it at his pleasure.

The points most worthy of imitation in this gentleman's management are the *order and economy of his stable.* He justly observes, that grooms are wasteful of hay, and by allowing the horses an unlimited use of it, tempt them to eat too much: his stables, therefore, are without racks: the loft above contains the machinery for cutting and grinding the chaff and corn, and, when prepared, each horse's provender is put into a tub, from which a tunnel leads to the manger underneath, by means of which it is conveyed to him without further trouble. It is given in small quantities at several times during the day, and at night enough is thrown into the tub to last until the morning. This is a most excellent plan, and might be still further improved by a contrivance in the tunnel to prevent more from descending than the horse will eat at one time.

The method of converting the entire provender into manger-meat has been borrowed from Flanders, in which country it is the universal practice, and the farm-horses are invariably in high condition. Its value consists—

1st. In its requiring a more thorough mastication of the food than when it is given in the common way, thereby assisting digestion, and consequently promoting the nutrition of the animal; for, it is not only true that old horses lose much of the power of mastication, and that young and greedy cattle are apt to devour a considerable part of their corn entire, when it is given alone, which passing through them in the same state, affords no kind of nourishment, but all animals are known to derive nutriment from their solid food, in a certain degree, in proportion to the care with which it is chewed.

2nd. It is consumed in less time.

3rd. By the mixture of the materials, some portion of which, as damaged hay, or straw, might be refused if given separately, an equal consumption of the whole is secured.

4th. By its admitting of being more readily weighed, or measured, than when given separately, it can be more accurately distributed to each horse; on which it may be observed, that more injury is often done to horses by allowing them an unlimited quantity of rack-meat, than even by stinting them to a scanty allowance; for they will not only pass whole nights in eating, when rest would do them more service, but, by this extraordinary distention of the stomach, its powers are weakened, and their general health is injured.

5th. It prevents waste, and consequently it goes farther.

Many exaggerated accounts of the saving thus made have been published, some of which state it as high as one-third, others even one-half, of the rack-meat: these are only calculated to mislead, or, by their improbability, to cast a doubt upon the testimony of those who have made such statements; but, according to the opinion of Messrs. Wiggins, whose business extends to the daily feeding of more than three hundred horses, it may be fairly estimated at one-sixth. These advantages are so obvious, that it is unnecessary to press them upon attention; but it must be admitted, that the practice is attended with the inconvenience

of occupying more of the carter's time,—independently of that employed in cutting the chaff—than the customary method; for horses being apt to blow upon manger-meat, and then to reject it, when given in a large quantity at one time, it must be administered with a sparing hand, and renewed when the manger is empty, thus requiring constant attendance until the last feed is put in.

Before quitting this subject, it may not be irrelevant to advert to the custom of giving *oats in the straw*, cut together, which, although recommended by some eminent agriculturists *, and common in many places—especially in East Kent, where it is mixed with the barn-chaff, provincially '*taff and chaff, and colder* †,'—only deserves notice in order to be reprobated. Throughout the greater part of that county, the regular mode is to employ a man and a mate to each team of four, when two turns of work are made in the day. The time of going to work is six in the morning, returning at ten, and then going out again at one until six: nine hours in the whole. It is the carter's business to bait the team from four in the morning until six, and the mate takes that duty during noon, and from six till ten, when the stable is shut for the night. The food is wholly cut into chaff, and the corn, whether beans or oats, *cut with it in the sheaf.* The only advantage attending the practice of cutting the oats is the paltry saving of threshing, while it precludes all knowledge, beyond a vague guess, of the acreable produce of the crop, the quantity of corn for the whole number of horses, or the share which falls to each, and it may be confidently pronounced a slovenly and unfarmer-like practice.

NUTRITIVE VALUE OF FOOD.

The next consideration is the *relative nutritive value* which the different kinds of *winter food* in common use bear to each other. Although chemistry has enabled us to ascertain the component parts of vegetables, and it may be presumed that the worth of all articles of cattle-food is in a great measure proportionate to the quantity of soluble, or nutritive matter which they contain, yet it has not clearly demonstrated that such proportions actually denote their exact degree of merit. The essential elements of vegetables consist of what chemists call hydrogen, oxygen, and carbon, in various proportions, combined in some cases with a small quantity of azote, and the different combinations of these produce gluten, or albumen, saccharine matter, mucilage, and starch. Gluten, which is the most nutritious, is nearly allied in its properties to animal substance; saccharine matter may be considered as possessing those of sugar, and mucilage those of gum: there is also an extract which is not supposed to contain any nutritive matter, but has been found useful to animals in a medicinal view. According to an analysis, made by Sir Humphry Davy, of the amount of those substances found in 1000 parts of different kinds of corn and pulse, it appears that the following are their proportions in those employed as food for cattle.

Grain.	Whole quantity of soluble, or nutritive matter.	Mucilage and Starch.	Saccharine matter or Sugar.	Gluten or Albumen.	Extract, or insoluble matter.
Norfolk barley	920.	790.	70.	60.	—
Yorkshire rye	792.	645.	38.	109.	—
Scotch oats	743.	641.	15.	87.	—
Common beans	570.	426.	—	103.	41.
Dry peas	574.	501.	22.	35.	16.‡

* Parkinson: *Essay on Live Stock*, vol. ii. p. 168. Middleton: Survey of Middlesex, 2d Edit. p. 462

† Kent Report, 2d Edit p. 183. Complete Grazier, 5th Edit., p. 175—177

‡ Elements of Agricultural Chemistry, 4to. p. 131.

But these results have been obtained by experiments made through solution in water, and it is not improbable that both the action of chewing the saliva, and the solvent juices of the stomach, may have a very different effect upon the food when it is eaten; for they are more beneficial in their joint operations than mere solution by common water, and the properties of grain are known to change, or to be lost, in the processes of malting and baking. It is also possible that certain combinations of those substances may be more nutritive than others; and therefore, although the chemical tests have thrown considerable light upon the subject, they yet cannot be deemed conclusive. There appear, indeed, to be about as many varieties of extract as there are species of plants: the difference of the properties probably in many cases depended upon their being combined with small quantities of other vegetable substances, or to their containing different saline, alkaline, or earthy ingredients. It is probable that the excellence of the different articles as food will be found to be in a great measure proportional to the quality of the nutritive matter they afford; but still their quantities cannot be regarded as absolutely directing their value. Experience, however, which is the farmer's surest guide, has to a great extent confirmed the accuracy of the analysis, and has in this instance added one more to the many existing proofs of the assistance which husbandry derives from science.

On reference to the table, it will be seen that oats are greatly superior in nutritive matter to beans; but this must be understood with regard to their respective weight, for, used as they are in England, by measure, and taking the average weight of a bushel of common horse-beans at 56lbs. and of Scotch oats at 40lbs., the difference between the two will be as 31,920 to 29,720, or nearly 16 to 15 *per bushel* in favour of beans. The same remark will nearly apply to the relative value of pease; with this distinction, however, that as they contain less gluten than beans, they are perhaps neither so heating, nor so nutritive, and experience has shown them to be more flatulent.

The *difference in weight* of the various grain used in feeding horses is not in general sufficiently considered. Most people look only to the prices, and finding beans at perhaps 5*s.*, when oats are only at 3*s.* 6*d.* the bushel, they conclude that the latter are cheaper in that proportion: without reflecting that, were the bushels weighed, the prices would be found nearly equal, and that, were feeding regulated by weight, the cost of either would be about the same *.

The custom of *feeding by measure* has led to a prevalent idea that beans are more nutritive than oats; though, weight for weight, we have seen that the contrary is the fact; and both that and the heating quality ascribed to them has probably arisen as much from the greater amount in an equal measure, as from any other cause; for, although it would appear that a bushel of either contains nearly an equal portion of nutritive matter, yet bulk, or weight, is also of importance in feeding, and it is certain that, in practice, an equal measure of beans is superior to the same quan-

* Taking, for the sake of round numbers, the average price and weight of oats, at 3*s.* 4*d.* and 40lbs. per bushel, they would be worth a penny the pound; and the relative value to them, of other grain used as horse-food, at their common average weight, when of equally good quality, would be,

	Oats.	Tick Beans.	Common Horse Beans.	G. Pease.	Barley.	Rye.
Weight .	40lbs.	60lbs.	56lbs.	60lbs	50lbs.	52lbs.
Price .	3*s.* 4*d.*	5*s.* 0*d.*	4*s.* 8*d.*	5*s.* 0*d.*	4*s.* 2*d.*	4*s.* 4*d.*

tity of oats. It also occasions constant irregularity in the common feeding with oats alone; for these vary in weight, according to soil and season, from 30lbs. to 42lbs., and even more, per bushel: thus a quartern of good feed oats, which ought to weigh 2¼lbs., is often reduced to 2lbs., and though the horse is thereby deprived of one-fifth of his corn, yet, the same measure being thrown into the manger, the fact is seldom adverted to.

The following table * will show the quantity of meal that is usually extracted from certain weights of that grain; and, though different results may be obtained by various qualities and seasons, yet the progressive ratio of the produce will generally be found nearly similar:—

	lbs.		lbs.	oz.		lbs.	oz.
Weight per bushel avoirdupois.	42	produce in meal	25	2	ditto in husk	16	14
	40	"	23	6	"	16	10
	38	"	21	12	"	16	4
	36	"	20	3	"	15	13
	34	"	18	11	"	15	5
	32	"	17	5	"	14	11
	30	"	16	1	"	13	5

Rye is very generally employed as horse-food in North America. It is there given coarsely ground, and sprinkled over straw and clover chaff, previously wetted, by which means the whole mass is well incorporated; mastication also is so much assisted that no part is wasted, and the condition of the carriers' horses on the roads in Pennsylvania, where they are universally thus fed, and are seldom lodged in a stable, proves the excellence of the practice. It is also used in Germany; but generally in the shape of bread made from the whole flour and bran, and it is not unusual in travelling through some parts of that country, and of Holland, to see the postilions help themselves and their horses from the same loaf. The plan of giving bread to horses was formerly adopted in some racing-stables in England, and the statute-book contains many acts of parliament regulating the making of horse-bread. In later times wheaten bread of the finest quality was used, from an idea that the superior weight and value of the grain, and its well-known nutritive power, when the flour alone is converted into bread, would render it more invigorating than oats: but the experiment did not succeed, and it furnishes one among many proofs, that reasoning from analogy alone will sometimes lead to erroneous conclusions.

Barley is rarely used in this country for horses, and rye perhaps never, or only by chance; yet throughout the south of Europe, the former, along with straw, is the only food given to horses and mules, the latter of which go through very severe labour, and are generally in high condition. There are various opinions concerning its properties—some considering it as more heating, others as more cooling, than oats, and all perhaps equally ill-founded. Where constantly used, it is not seen to have any prejudicial effect; and, as it appears to contain a larger portion of nutritive matter than oats, and is known to be more fattening, it is well worthy of attention, especially as the price is so much affected by mere colour, which is of no importance in feeding, that inferior malting samples frequently fetch little more than feed oats of good quality. Six bushels have been found, on comparative trial, to be equal to eight of oats †.

* Survey of Antrim, p. 183. See a future chapter, on the cultivation of oats, in this publication; and also the Farmer's Magazine, vol. xvi. p. 188, vol. xvii. p. 413, and vol. xx. p. 308.

† *Marshall's Minutes of Agriculture*, Digest, p. 43. In another experiment, besides that mentioned in the foregoing table, Sir Humphry Davy states the difference between 100 parts of oats and barley to be—

Fine

The British cavalry was fed on barley during the greater part of the Peninsular war, and throve upon their allowance, though it was *delivered by weight*, and was only 10lbs. instead of 12lbs. of oats; the barley being considered in that proportion more nutritive than oats, owing to the smaller quantity of husk.

Now it follows from this, that we have no guide on which we can more securely rely than the weight of vegetable nutritive matter to regulate its consumption. Yet it has been contended that, in the feeding of farm-horses, barley—though heavier than oats, and containing a larger quantity of extractive matter—does not contain so much nutritive substance. It is said to be more watery, and therefore, if given weight for weight, to deprive horses of a portion of their regular nutriment. An article in the 'British Farmer's Magazine *,' indeed, states the saving on feeding with barley as amounting to 6*l.* per annum for each horse; but that grain was given, instead of oats, by weight, without any distinction between the respective nutritive qualities of either; nor does it appear whether the statement was made from the actual experience of an entire year, or was only assumed to amount to it, from a calculation made on the savings of a shorter period.

An account of its uses, in many instances, by Sir John Sinclair †, states its being almost uniformly given with one-third of beans, bruised or broken with the barley, or boiled, which is considered the better plan; though it certainly was not boiled for regimental service, nor is the proportionate quantities of barley and beans to oats stated: we are also led to believe that the former have been in most cases given *by measure*, in consequence of the cheaper price of barley. *Bere*, or *Big*, we also know to be sometimes substituted with economy for oats in the north, but the difference of weight is not considered: in Norfolk, too, Marshall tells us that, when barley is unsaleable at regular markets it is sometimes given to horses, in which case it is usually 'malted,' that is, steeped for a few days until it begins to vegetate, in which state it is thought to be less heating than when given in the natural state. Being, also, frequently badly harvested, the pernicious effects of heat, or must, are prevented by boiling.

We will not hazard an opinion on the proportionate value of oats and barley, which can only be fairly tried by first depriving two horses for some days of any kind of corn, and then feeding them for a considerable time upon equal weights of each grain; but we certainly do feel somewhat sceptical about the value so loudly insisted upon of late, of *boiled corn* as food. That post-masters' horses, which get an unlimited quantity, may be benefited by it, we will not deny; and a mash of boiled barley twice a week will be found to improve the general health of the animals, as evinced by the sleekness and glossiness of their coats, as it certainly has an opening and cooling effect on the bowels, which cannot but be serviceable when large quantities are consumed of heating food; but we may be permitted to doubt either its necessity or its utility for farm-horses, commonly fed: or that they require, in the winter months, more cooling food than a bran mash, instead of their corn, with an ounce of nitre, or common salt, on the Saturday night.

Fine Norfolk barley		Sussex oats
79	Starch	59
6	Gluten	6
7	Saccharine matter	2
8	Husk	33
100		100

Elem. of Chem., Lect. III.

* No. IV. p. 486; but see also No. V. p. 657.

† In the British Farmer's Magazine, No. XI. p. 171.

There is also a fact stated upon the authority of Sir John Sinclair, respecting the heating effects of unusually large quantities of corn upon the health of horses, which is well worthy of attention. It is that of an extensive coach-master, who regularly allowed 3 bushels of oats daily to each of his sets of eight horses, out of which, during the course of many years' experience, he annually lost a great number. Upon reflection, however, he changed his mode of feeding, and allowed instead for each set,—

1 bushel of beans,
1 ditto oats,
1 ditto hay and straw cut into chaff;—

the consequence of which was, that his horses were as hearty and as able to perform their work as they were ever known, and that he has only lost one since the adoption of that plan*.

In gentlemen's stables no other than *meadow-hay* is generally admitted, and it is in all respects the best; but farmers find more profitable uses for it, in the feeding of fatting stock and cows; and clover, either alone or with rye-grass, sainfoin, or tare-hay, though coarser, answers every necessary purpose for farm-horses, more especially when cut into chaff and used along with straw. *Sainfoin* is commonly esteemed the first, and *clover* the next in quality, but *tare-hay*, if well made, is very hearty food: they are, indeed, so nearly alike, that it is unnecessary to dwell upon their peculiar properties, and, were there even greater difference between them, there is seldom much room for choice, as whatever may be the produce of a farm, it must be consumed, and no one thinks of purchasing fodder for the working cattle.

EXPENSE.

From the foregoing statements, the necessary information may be collected as to the quantity and kind of food on which farm-horses may be supported at constant labour. They lead also to the important consideration of the *annual cost of a team*, and of the labour it may be expected to perform, without an accurate knowledge of which no correct estimate can be made of the general expenses of cultivation, or of the particular charges on separate crops.

The quantity of the different articles of food, in fact, depends on the size of the horses and the labour they perform; the value, upon the prices of different seasons, and in every season upon the situation of the farm in respect to markets, particularly hay and roots, which bring very different prices at large towns, and at a few miles distance. It is for these reasons that the yearly expense of a horse's maintenance has been estimated at almost every sum, from 15*l.* to 40*l.* In the Lancashire Report †, the cost of a team of three, ploughing seven statute acres per week the year throughout, is thus estimated:—

	£	s.	d.
Oats, six bushels per week for six months, at 23*s.* per quarter	19	10	0
three ditto . *six ditto* . . .	9	15	0
Hay, six months at £1 1*s.* per week	27	6	0
Grass and green food 15*s.* per ditto . . .	19	10	0
Wear and tear of two ploughs	3	3	0
Shoeing, 10*s.* 6*d.*, and farm expenses 5*s.* each . .	3	6	6
	£81	10	6

* Scottish Husbandry, vol. ii., Append., No. 23.
† Original and Corrected Report, p. 584.

In the General Report of Scotland *, the feeding is calculated on some farms as high as 15 quarters of oats each, with 22lbs. of hay, or an English acre of clover or tares, and a quarter of an acre of potatoes, yams, or Swedish turnips while they are on straw; and thus the expense of keep— oats being 25s. per quarter—is estimated for a pair at—

	£.	s.	d.			
Interest on purchase, decline in value, and insurance from disease	15	12	0			
Food	73	2	6			
Harness, shoeing, and farrier	6	0	0			
				94	14	6
Mr. Brown, of Markle, makes the charge of a plough-team of a pair with driver, amount to †				135	1	0
Mr. Kerr, of Berwick ‡				120	0	0
While others reduce the charge of a pair and driver more reasonably to §				90	0	0
and others again to ‖				80	0	0
Mr. Middleton, of Middlesex ¶ raises it to				157	10	0

But these estimates were made at various periods, when great difference existed in prices; the Middlesex report is rather meant for the road than for common plough-work; and perhaps the present general average of the kingdom, exclusive of the charge for interest, may be calculated at about 84*l.*

Some farm-horses, though working at the usual rate of common labour, are said to be supported during the summer on cut grass, almost without corn. 'When no beans are grown, their winter food is oat-straw or hay; but in all other cases, bean-straw alone forms their winter provender, from grass to grass, with a mess every night of bean-chaff, potatoes or turnips, and a little small corn, all boiled together and seasoned with salt; and two feeds of oats per day, but only when hard worked **.' On this fare they are stated to be kept in excellent condition, and others are said to consume only from 15 to 25 bushels, if good oats are given; but as draughts (*light corn*) are commonly used, the quantity is proportionably increased ††. Now, if the meaning of this be, that a cart-horse gets no more than that quantity in one year, it must be either made up of other nourishing food, or he must be so badly fed as to be unfit for work. And, notwithstanding all that has been said of substitutes for grain—although admitting that roots may be economically and even healthfully substituted—we must beg leave to doubt this possibility when the animal is forced to exert himself to the extent of his power. In proportion to the work which he usually and regularly exerts, he may be in excellent apparent order: but push him; try him with a few days' harder than ordinary toil, and you will find that it is not an additional quantity of roots, but of sound corn, that he requires to sustain him. The reason is evident: he may fill his stomach with roots, but they will not supply the quantity of invigorating and nourishing substance which corn supplies *in the same weight;* and having filled it, he can do no more. Therefore, we repeat, that farm-horses moderately worked may do their regular day's labour with perfect satisfaction to their employer; but compel them to the

* Vol. iii. p. 194. † Sir J. Sinclair, Husbandry of Scotland, p. 125.
‡ Berwickshire Report, p. 406. § West Lothian Report, p. 178.
‖ Library of Useful Knowledge, Farmer's Series, No. 18. Dumbartonshire Report, p. 251.
¶ Middleton's Middlesex, p. 97.
** Essay on the Agriculture of the Vale of Forth, by Mr. Carmichael.—Prize Essays of the Highland Society, 1833, vol. iv. p. 24.
†† Smith's Survey of Galloway.

full extent of their vigour, and there will be no advantage found in stinting them. When working cattle, more especially horses, are not judiciously as well as economically fed, they are either suffered to go out of condition, or provender is unnecessarily wasted; and thus, in either case, considerable injury is sustained through their deficiency of strength to perform their proper quantity of labour, or through the unnecessary expense of their keep.

Some years horses will require more corn than in others; sometimes soiling commences sooner than at other seasons; and at others, from the failure of the second crops of grass, they are sooner put on hay and corn. The hay, too, has not the same succulence in some years as in others, and consequently will not go so far; and horses, like other animals, though of the same apparent strength, do not all consume similar quantities of food.

In treating this subject minutely, it would be necessary to review the various methods of feeding horse-teams, practised by different eminent farmers, but, besides that, the enumeration would be tedious. Few men require such assistances to their judgment in forming an opinion of the most eligible mode, and it may be sufficient for the present purpose to assume that plan which can be most generally adopted, namely—of feeding upon corn and hay, or straw, during the winter, and soiling in summer; leaving out of the question the savings which may be made by the most economical employment of roots. Five horses will also be assumed as composing a team; for, even if ploughed in pairs, three are sometimes wanted for other work; an odd horse is always useful; and with the aid of the farmer's own nag to hook on occasionally to a third plough, a couple of hundred acres of medium soil, under a moderate rotation, and with a fair proportion of meadow, may be very well managed with that number, if there be not much out-cartage; and they may be easily worked by one carter and his mate, with a stout lad able to hold and drive, or one of the labourers, when a third plough is required. Supposing, then, the horses to be soiled from old May-day to Michaelmas on grasses worth 6*l.* the acre, with two quarters of oats each, at 24*s.*, to be given on working days, and from that time to be allowed each 10lbs. daily of bruised beans, ground oats, or barley, with 12lbs. of clover or sainfoin hay, and 20lbs. of straw or haulm for both chaff and litter; and calculating that quantity of each species of grain to be worth 9*d.**, hay at 65*s.*, and straw, or haulm, 20*s.* per ton †, on the farm—which may be about the present home value of the best qualities in most places—the cost of feeding and farriery would be:—

					£	s.	d
One horse Summer soiling	20 weeks, 140 perches at 9*d.*	5	5	0			
	2 qrs. oats „ 24*s.*	2	8	0			
					7	13	0
One horse winter-feeding per week.	Corn 10lbs. per day at 9*d.*	0	5	3			
	Hay 1½ truss „ 19¼*d.*	0	2	5¼			
	Straw 1¼ cwt. „ 1*s.*	0	1	3			
	32 weeks . .	0	8	11½ =	14	6	0
	Shoeing and farriery . .				1	10	0
					£23	9	0

* See note, p. 145, but those are assumed as the market prices; here they should be lower.

† In point of fact, no charge should be made for straw when it is not allowed to be sold; for, if not eaten, it must be consumed as litter; and when charged to cattle, it must be again allowed for, in account, as dung.

The annual charge of maintaining a single horse being thus ascertained, there remains to be added to the collective expense of the team, the interest of the capital sunk in their purchase, and in that of the implements for their use, including a waggon and carts, with their gear; and allowing these to cost 140*l.*, and the horses and harness, one with another, to stand in 26*l.* each, with ten per cent. for repairs and deterioration of value, the whole account will appear thus :—

		£.	*s.*	*d.*
Maintenance of 5 horses at £23. 9*s.* each		117	5	0
Interest on £270, cost of teams and implements, at 5 per cent.	£13 10 0			
Repairs and deterioration of ditto at 10 per cent.	27 0 0			
		40	10	0
First carter *—weekly wages	31 5 0			
Second ditto—annual wages £10 0 0, board at 6*s.* per week 15 12 0	25 12 0			
		56	17	0
Stable and contingent expenses		10	0	0
		£224	12	0

LABOUR.

The *annual labour* of a man and a pair of horses, with the necessary implements, will therefore cost 89*l.* 16*s.* 2*d.*, or, throwing fractional parts aside, 6*s.* for every working day ; but, as many days occur on which they are only half, or not at all employed, more than five days in each week, or 260 in the year, cannot be calculated on, which gives nearly 7*s.* per day as the actual expense ; and presuming them to be adequate to the cultivation of 40 to 60 acres, the tillage in each case will cost—

89*l.* 16*s.* 2*d.*	40 acres =	2*l.*	5*s.*	0*d.*	per acre.
	50 „ =	1	16	0	
say 90*l.*	60 „ =	1	10	0	

It will perhaps be objected, that as all the other work of a farm, such as statute-labour, carriage of materials for drains, repairs, &c., is also performed by the same teams, the entire charge should not fall upon the tillage ; but, as all those operations are incidental to the cultivation of the land, they may, in fact, be regarded as forming part of it, and any separate estimate would not alter the total amount of the annual expense. Whenever it may be material to ascertain the actual cost of any specific work, the time it occupies being known, the calculation can be readily made according to the above valuation ; and farmers would find it useful in enabling them to form a correct judgment on many points of great importance were they to make out an account of the actual expense of their teams, and to charge each day's work against the particular object on which it was employed. But in calculating the cost of the tillage of any one field, the mere charge of each day's ordinary work would be a fallacious guide ; for that would only show the labour actually expended on the land without any share of the incidental labour of the whole farm : in such estimates, therefore, the annual expense of the team must be divided by the number of days consumed in tillage only ; and supposing that to amount to but two-thirds of the entire labour, it would follow that, when each day's labour throughout the whole year costs 7*s.*, the charge for a day's ploughing should be 10*s.* 6*d.*

* See page 121.—The estimate of wages and board for each of the men is taken between the highest and lowest rate ; for out-door and in-door servants were both kept either in, or out of the house—the amount, at a medium rate, would be near similar.

The *daily labour of a team* must necessarily be regulated by the manner in which it is employed, as well as by its strength. In some of the southern and midland counties, the carters, who generally sleep in the house, rise at four in the morning, feed, clean, and harness the horses, get breakfast, and are ready to go a-field at six o'clock, or after seven in the winter, when they work till two, thus making at the utmost a yoking of eight hours. When the horses return to the stable they have a little hay given to them while their attendants have dinner, by which time it is past four, when one of the men curries, feeds, and litters them down, while the other fetches their provender, either green or dry, and usually finishes his evening by a lounge at the smithy, either to get the plough-share pointed, or to have some talk with his fellows, until the hour of eight leads him home to supper. Throughout the north, however, the usual hours of work are, in the spring and summer, from six to eleven, and from two to six, or seven, allowing the intermediate three hours for rest and feeding: in winter, at the utmost, from seven to four, with one or two hours' rest at mid-day; though, at that season, it is a better practice to finish the day's work, without returning to the stable, at one bout of seven hours, during which the horses may get a feed from their nose-bags, while the ploughman takes his lunch, which he carries with him to the field. The common calculation is, that, taking the year round, an acre of land is thus ploughed in a day; and, generally speaking, this may not be wide of the fact: but the exact quantity, and the requisite number of horses must depend upon the nature and condition of the soil; the season; the way in which the work is performed; and the sort of cattle employed. Notwithstanding the broad assertion 'that two-horse ploughs are fully adequate to the tillage of any soil, however heavy *,' it is certain that there is land in the Weald of Kent, and the adjacent similar districts, so exceedingly stiff and wet, that four powerful horses, or six strong Sussex oxen, are sometimes brought to a stand still in breaking it up †: the mode of ploughing, too, sometimes requires that the horses should go at length, in which case three are hardly more efficient than a pair abreast; and it is well known to practical men that, even with apparently proportionate additional strength, an acre of stubborn clay cannot be broken up in the same time as a ley of friable loam. Much ingenuity has been exercised to facilitate the execution of field-labour; various forms of the plough have been constructed to operate with less resistance, and the work has been executed by the application of less power. This is, no doubt, a great improvement, when the purpose can be equally well attained. It is pleasant to see a ploughman conduct a pair of well-trained horses to the field, and in a masterly manner perform the work which formerly required the aid of an awkward ploughboy and a number of unwieldy animals; and when the implements are good, and the ploughman intelligent and dexterous, this, no doubt, may be done. But it has been well observed, by a writer of great experience ‡, that 'fashion overrules judgment, and two ill-appointed animals are often expected to perform that which is task sufficient for the most powerful; the surface is slightly scratched, attention to preserve the depth of the soil is disregarded, and the progress of cultivation and fertility retarded.' Ade-

* Quarterly Journal of Agriculture, No. XI. p. 714.

† Kent Report, 2d edit. p. 20. Surrey Report, (Stevenson's,) p. 195. In some of the red clay land, in the Newbury district of Berkshire, *five* horses find hard work in turning up three-quarters of an acre in a day. Berks. Report, p. 119.

‡ John Naismith, Esq., part. iv. No. i. of the second volume of the Appendix to the General Report of Scotland.

quate force should be employed to stir the ground to such a depth as a healthy vegetation requires; the breadth as well as the depth of the furrow, too, and the pace at which it is turned, govern the quantity that can be ploughed in a given time. The ground gone over in ploughing an acre is, with a broad furrow-slice, about eleven miles, or with one of eight inches, twelve miles and three furlongs, exclusive of turnings; and it has been ascertained, that a team, walking at the different rates of one and a half and two miles an hour, will plough the following quantity of a medium soil, to the depth of five inches, nine hours:—

	Inches.			A.	R.	P.
Breadth of furrow . .	8	at 1½ mile per hour	. .	1	0	0
	9	,, ,,	. .	1	0	20
	8	2 ,,	. .	1	1	10
	9	,, ,,	. .	1	2	0

The difference in the quantity ploughed in these instances clearly demonstrates the value of action in the horses; but it must at the same time be observed, that the distance travelled at the slow pace is only twelve, while at the quicker rate it is sixteeen miles; and that a ploughman must possess more than ordinary strength and dexterity to go through that degree of labour, and perform it well; for although he may rest himself occasionally by means of the plough tail, yet that is always at the expense both of the cattle, and of the regularity of the work. Mr. Parkinson mentions an instance of an Irish ploughman who, in a medium soil, and with a nine-inch furrow, turned over at the second ploughing, with a pair of horses of the heavy dray kind, 1 acre and 20 perches (Irish measure) in six hours and ten minutes, which is at the rate of nearly 2 acres 2 roods in eight hours; the horses must therefore have walked during that time at the rate of three miles an hour; but he admits that no horses, with any keep, could have maintained such daily labour for a continuance*. On the whole, therefore, it may be concluded, that an acre and a half is the utmost that can be ploughed with a common furrow, on any soil; and that, on an average, from an acre, to an acre and a quarter, in summer, and three-fourths of an acre in winter, may be considered as the day's work of a team; the strength being in proportion to the land.

CARTAGE.

The labour of *cartage* being applied to a great variety of objects, and depending as much upon the goodness of the roads and carriages as upon the strength of the cattle, no certain estimate can be formed of the weight which can in all cases be drawn by one horse, though a sinewy medium-sized animal, in good condition, will draw a ton, and powerful cart-horses, highly fed for road-work, considerably more; but, in most cases, it may be assumed that a common farm-horse is only equal to a load of 15cwt. The great roads throughout most English counties have been of late years much improved; yet still, many of the cross-roads are in several places almost impassable during the winter. The highway laws and turnpike regulations are indeed still very defective; and we should strongly recommend the adoption of the system which has lately been introduced into Scotland, the whole working of which is excellent †. It is admitted by all

* Parkinson on Live Stock, vol. ii. p. 132.

† The distinguishing features are—

First—Each county of Scotland has a Highway or Statute Labour Act, suited to its peculiar and local circumstances.

Second—The trustees are the same as the turnpike trustees: these also levy county rates.

writers upon political economy, that the state of the public and private roads is one of the first criterions of wealth, and that, as these are either good or bad, so may the extent of its commerce and civilization be judged of; yet there are few parishes in England where the bye-ways approach to anything like a state of perfection: there are thousands in which they are a disgrace to the age and country. Yet their condition is not owing to ignorance in the art of road-making; for in or near every parish there is a well-constructed and well-managed turnpike-road, offering an excellent model for imitation. The expenditure on good roads may not appear to a vestry of farmers to return so direct a profit as that laid out in ploughing and sowing; but its profits are equally certain, since it must cause a very considerable diminution in the wear and tear of their carts and waggons, and the number of the horses in their teams; and indeed we have Mr. Macadam's authority, given in his evidence before the late committee on the Highway Bill, for believing that all the bye-roads of the kingdom might be kept in turnpike-road condition for less money than, taking one thing with another, they now cost *.

There is in fact, however, no evasion that is not resorted to, to avoid statute labour, or working upon the roads: sometimes the worst horses are sent: at others a broken cart or an old man, past labour, to fill; in fact, 'what is every one's business appears to be nobody's,' and unless the surveyor happens to be a man of unusual strictness and acquaintance with the business, it is sure to be neglected. A remedy might perhaps be effected by the abolition of all personal service upon the highways, and by the appointment of regular surveyors, who should have the power, under the authority of the magistrates, to raise whatever sums may be necessary for the repair of the roads within their respective parishes and townships.

It has been suggested as indispensably requisite for the public accommodation, that one standard width should be fixed on for the track of all wheel carriages, than which nothing perhaps would contribute more to the safety of travelling throughout the kingdom. The width might be suggested at five feet eight inches from the strike, or felloe, of one wheel to that of another, and the wheels of pleasurable carriages moving at that width would render them safe and commodious, while at the same time very sufficient space would be afforded between the wheels for the body of a cart or waggon †; but there are many cross-roads which would not admit of the breadth of track, and it may also be doubted whether the uniformity of distance between the wheels would not tend to the wearing of fixed ruts and the injury of the roads. It has indeed been hinted, on the contrary, as an improvement upon waggons, that were the fore-wheels placed 6 inches wider asunder than the hind ones, the track, being thus 16 instead of

Third—A commutation in money universally obtains—no labour is demandable.

Fourth—The money is expended under the direction of scientific road-makers—well paid.

Fifth—The money payment is made, according to circumstances, in different proportions, by landlord and tenant, varying in every county.

Sixth—In the larger counties several parishes are united into one district.

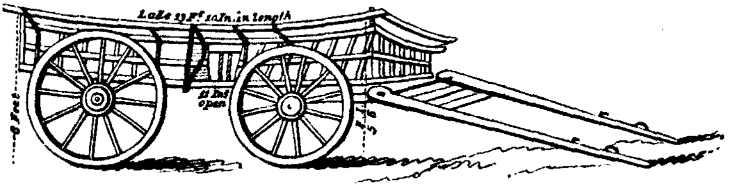
Seventh—The roads are now universally good throughout Scotland, though a power of indictment is a desideratum.

* Quarterly Review for December 1832, No. XCIV. In the Survey of South Wales it is said 'that the parochial roads are so narrow, and so cut up by the waggon-wheels always traversing the same track, that no road-work can be done by yoked oxen.'—Survey of South Wales, vol. i. p. 291.

† Vancouver's Survey of Hampshire, p. 504. See also the very pointed observations of Mr. Malcolm on the general state of our roads, in his Compendium of the Modern Husbandry of Surrey, vol. iii. p. 286.

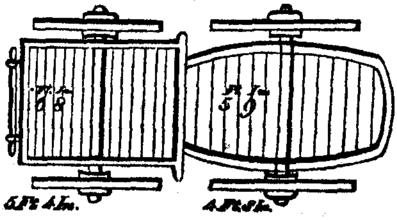
9 inches, and being more equally spread over the surface of the road, would not form such deep ruts, and their breadth would become good horse-paths for post-chaises and all quartering carriages to run in. The fore-axletree, too, being wider than usual, does not touch the lock so soon as other waggons, and consequently affords an advantage in turning: it might also be advantageously used on grass lands to prevent the pressure of both the wheels upon the same track.

The superiority of *four-wheeled waggons* drawn by the common team of three, or four, or of two-wheeled carts, drawn by one or two horses, has long been a subject in dispute. In Scotland, the pre-eminence of single horse-carts over every other kind of carriage, for all sorts of farm work, is loudly contended for, and in most cases can hardly admit of doubt. On a good turnpike-road a single-horse cart will carry a proportionally heavier load, and they are less injurious to farm-roads than waggons; but, although they have been very generally adopted throughout the north, and partially by individuals in other parts of England, yet in the south—although tumbrels and other small carts are commonly used for carrying out manure, and other purposes on the land—habit and prejudice, if not more solid reasons, still give the preference to the waggons, for the road. Of these, the various kinds are almost as numerous as the counties in which they are used; fashion in some, and experience in others, dictating the difference in shape; the common principle of their construction is, however, nearly alike, but as varieties occur which are in some places considered of moment, we shall notice a few of the most prominent sort used in different counties. That adopted in Sussex—the body and frame of which are here depicted—affords a fair specimen of the generality, and is as useful as most, with the additional advantage of higher fore-wheels, and greater capacity for stowage.



The bed being narrowed behind the fore-wheels, as explained in the section of the accompanying figure, No. 1, allows them sufficient room to lock round in the shortest curve, by which means an advantage is gained in turning, and the carriage is more handy than when the floor is straight: thus—

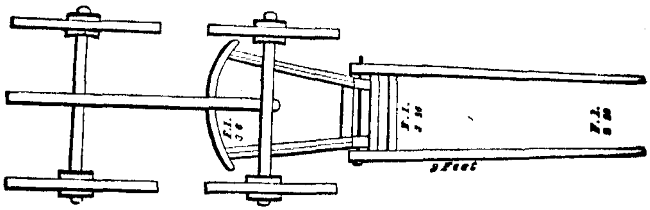
Fig. 1.



To this, however, it has been objected, that the body is thereby weakened, and its capaciousness diminished; it is, therefore, sometimes made straight, as in the front view of the body; in which case, a chain is passed from the

pillar of the waggon to about six inches before the middle bed-stay, which is of such a length as effectually to prevent the wheels from catching on the lock. The tail-board falls down, for the convenience of loading, and, being lowered by chains, may be so used as to extend the length of the body, or hind and fore ladders may be occasionally substituted, and are essentially useful in getting hay and corn off the field. The two-wheeled carts have also moveable ladders and carry almost as much as the waggons on level ground. These tail-frames have a roller at the hind end of the bed, which serves as a winch to tighten the ropes which secure the projecting load. The dimensions of both the bed and the carriage, as at fig. 2—

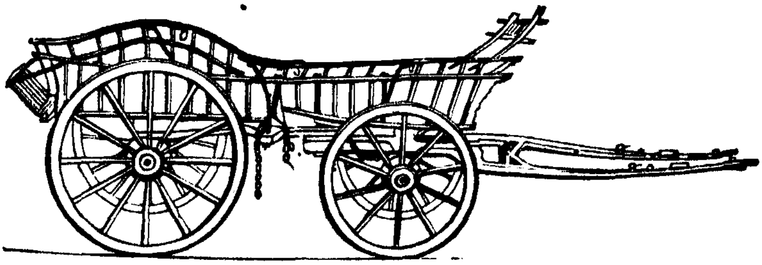
Fig. 2.



are marked in the figures, and the first cost of a narrow-wheeled waggon may be about 40*l.*, and a complete set of harness for four horses will cost nearly 20*l.* more *.

The capacity of the *Hampshire waggon*, which very much resembles the foregoing, contains, when level full, about 66 bushels. It is a compact model, generally firm and well built, with close-boarded or open raves. It is, however, commonly straight in the frame of the body, and is but rarely furnished with ladders, either before or behind, for the purpose of lengthening the body in hay-time and harvest, which additions would be desirable in the open down parts of the county, where the fields are often at a considerable distance from the homestead †.

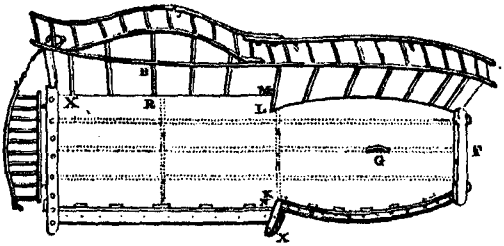
The *Woodstock waggon* is very generally admired throughout Oxfordshire, the top rails, which are curved over the hind wheels, affording it, as will be seen in the annexed view of it in working order, a great appearance of symmetry.



The three following figures are sections of the same implement, which are here described, as they will enable any ingenious country cartwright to execute a model, if it should be adopted in another place. Their chief dimensions are as follows:—

* Sussex Report, p. 261.
† Vancouver's Survey of Hampshire, p. 104.

Fig. 1.



	FT.	IN.
The length of the top rails is . .	12	4
Their breadth across	1	0
Depth of the side rail . . .	1	10
And from B to R	1	0
Length of hinder part of the bed from X to L	5	9
From L to the fore part of the bed . .	5	3
Breadth at F	3	8
Length at G below the axle . . .	2	0
Breadth of the hind ladder . . .	4	4
Breadth of the indenture at the fore bed, to allow of the locking of the wheels at N to X .	0	11

Fig. 2.

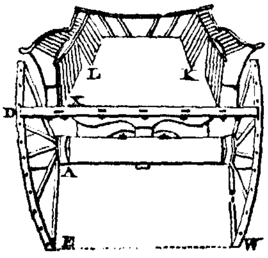
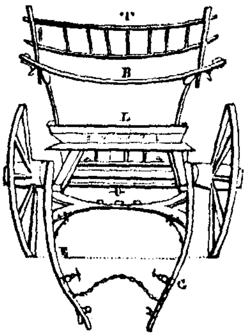


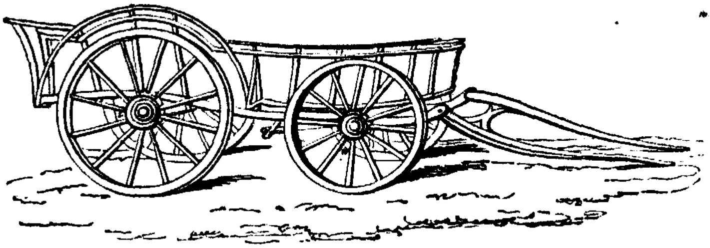
Fig. 3.



	FT.	IN.
L K is the breadth of the hinder floor	3	5
Length from X to the end .	11	0
Breadth of tail-piece at D .	6	0
Width of wheels at E W . .	5	2
Do. of upper part . .	6	6
Diameter	5	3

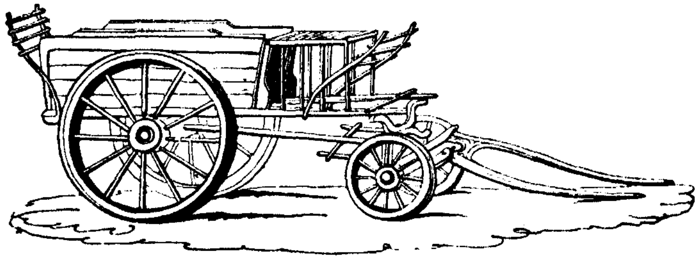
	FT.	IN.
T, breadth of fore-ladder .	4	3
Depth of do. to B . . .	1	8
Do. of the fore part of the body from B to L . . .	1	2
Breadth of shafts at E . .	3	10
Do. at G	3	3

The *Berkshire waggon* differs but little from this description, except in being lower built. It is a convenient size and good model, and when furnished with fore and hind ladders, carries a bulky load of hay and straw; but, the body not being so deep as that of the former, it does not contain so much when laden:—



The *Norfolk and Suffolk waggon* is remarkably heavy, which is the less necessary as the roads are good and the country very level. It is however made to lock so far under the bed, that it will turn as short as a post-chaise. It is 12 feet long, by 4 broad, and 2 in depth; but it does not carry so much as the Berkshire waggon, and it is a horse's draught heavier when loaded. The usual load is ten quarters of wheat, with four horses on turnpike, and five on bye-roads*.

The *Hermaphrodite waggon* is formed by uniting two carts, corresponding with the fore and hind parts of a waggon, by bolting them together: the thill of the hind cart passes under the bed, and rests on the pillars of the fore cart. The union is simple, yet so complete, as to render this kind of waggon as strong and serviceable as the common kind; and, when disunited, the carts are equally fit for all the uses to which they are commonly applied. This plan is common in Norfolk, where, with any one cart, and a pair of temporary old waggon-shafts and fore-wheels, they form a very useful harvest-waggon, as will appear in the annexed sketch.



The shafts of the cart rest on the bolster of the waggon-wheels, to which they are secured; and a very long copse, or fore-ladder, resting also upon the bolster, projects over the shaft-horse, to which a hind-ladder is also fitted. It is an uncouth machine, but it answers the temporary purpose for which it is intended: in small farms it is an object of real frugality, and in large ones a very material help in a busy season †.

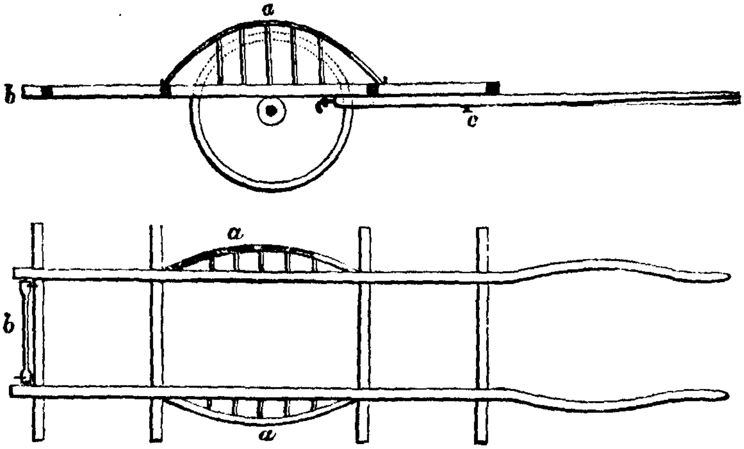
There are also two very light and unexpensive harvest-carriages, almost peculiar to *Cornwall*, but which, from their great simplicity and use, deserve a place on every large farm in the kingdom. One is a waggon of this form:—

* Young's Survey of Suffolk, p. 32.

† Kent's Survey of Norfolk, p. 118. Ample directions for the construction of these carriages, accompanied with plates, may also be found in Vancouver's Survey of Hampshire.

The body is open; a ladder of five bars before and behind gives it great length, and an arch over the hind wheel gives it breadth. The fore-wheels turn clear under the body, so that it can sweep round in a very narrow compass. The load is secured by two ropes tightened by a winch, or roller, fixed behind; and it carries about three hundred field sheaves of corn. A tongue, or middle-tree, or shafts, are alternately fixed to the axle of the fore wheels, as it is meant to be drawn by oxen or horses.

The other is the *two-wheeled Cornish wain*, of which the following is the plan; the upper figure representing the carriage-frame, and the lower the bed:—



At *a* are the wings, which prevent the load from choking the wheels; and at *b* a roller, with holes in it, in which are fastened the ropes which cross the load, and, taking a turn round the crooks *c*, return again to the back, and then forward to the other side, where it is fastened by the roller, which is wrought by two iron handles, in the manner of a smith's vice. It is made with either tongue-tree or shafts, as designed for oxen or horses, and will carry from two to three hundred sheaves. *It may be used* with the shafts and wheels of a common cart, in which case the only additional expense is the body; and, whether for the conveyance of faggot-wood or straw, or the expeditious clearance of the fields in hay-time and harvest, few implements can be better contrived *.

There is also a *bavin-tug*, or waggon which is much used in many of the woodland counties, and will carry 150 faggots, each 4 feet long, and 3 in the girth. The hind and fore wheels are 14 feet apart, by which the length of the carriage is much increased; the load lies consequently very low, and is thereby less liable to be turned over in narrow cross-coun-

* Cornwall Report, p. 38.

try roads, which in the Weald of Kent and the neighbouring districts are in some seasons almost impassable: it consists of a frame on which the load is fastened by ropes, and the cost does not exceed 15*l.* or 16*l.*

There is besides another carriage mounted on four low wheels, and called a *trolley,* which is found about many farm-houses in Leicestershire and the neighbourhood. It consists of a square frame resembling the bed of a waggon, 10 or 12 feet long and about 4 feet wide, boarded on the bottom; it is also fitted with thripples, or partial harvest-gearing, and the wheels being very small, the platform is only raised between 2 and 3 feet from the ground, which makes it very convenient for loading and unloading. It is used for carrying faggots, poles, posts, and rails, implements about the farm, stubble, or any odd fragment of hay or harvest; and, from its low construction, is much more handy for such purposes than a waggon of the common form, or even than a cart *.

The advocates for carts contend that there are but few articles, except long timber, which may not be conveyed on a carriage with two wheels equally as well as upon one with four; that single-horse carts are easier loaded and unloaded, handier for almost every purpose, and that six or eight may be driven by one man, with the assistance of a boy; that they are also less destructive to the roads than waggons, especially in hilly roads, where the wheels of the latter require to be locked; that they carry more in proportion than either waggons or carts drawn by two or more horses, and are consequently more economical,—in proof of which they produce an account of the weight of coals formerly carried by those vehicles at the collieries in Durham, from which it appears that

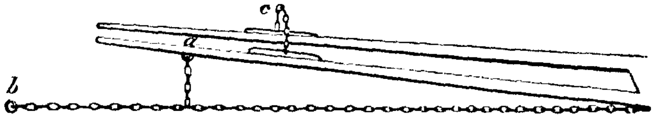
A two-horse cart carried . .	36 bushels,	weighing	29½ cwt.
A three-horse do. . . .	48	,,	39 ,,
A four-horse waggon . .	74	,,	60 ,,

Whereas, now, a one-horse cart carries 24 bushels, weighing 19½ cwt., and travels twenty-six miles in twelve hours †. There is thus an evident advantage in point of labour; but, against these facts, and this apparently plausible reasoning, those who support the old system maintain that single-horse carts require animals of superior power to effect such work; and that, each being supposed to draw an equal load, they are unfairly contrasted with waggons, in which the average power, only, of the team being exerted, inferior cattle may be used. They insist also that, besides the difference in value of the horses, those in the carts are, from their unvarying efforts, sooner tired, and the wear is consequently greater than in waggons, in which they can occasionally relieve each other; that the whole load being above the axle-tree in the carts, it throws so much weight upon the horse, in descending hilly roads, as to endanger his safety, while it equally impedes his exertions in the ascent; and that, while the one horse is compelled to use his utmost strength to overcome any sudden obstacle, the power of a team is, in a similar case, only applied to one-half of the load, which in the waggon rests equally on both pair of wheels: thus, supposing a ton to be loaded upon a cart, and that a short rut in the road is to be surmounted, the whole, being upon one axle, must be dragged out at once; but were the same weight upon a waggon, it, being divided upon the two axles, is drawn out at two separate pulls, the first of which clears the fore-wheels before the hinder fall in; and, although it be true that,

* Survey of Leicestershire, p. 66.

† See the Surveys of Durham, p. 257; Northumberland, 3rd edit., p. 192; Cumberland, 3rd edit., p. 272.

from their smaller diameter, the fore-wheels of the waggon would sink deeper into the rut than those of the cart, yet, as a skilful carter apportions the weight of the load to the diameter of the wheels, were 12 cwt. to be, in this instance, placed behind, the advantage would still be as 12 to 20 in favour of the waggon. There can, however, be no doubt that, were the fore-wheels made 10 inches more than common in diameter, there would be a great superiority obtained in draught over those of the common size, for the power of the wheel is in direct proportion to its radius, and to the freedom with which it revolves upon its axis; but in hilly roads high fore-wheels are not easily managed in short turnings, unless the bolstering be raised to an inconvenient height, and it can admit of but little question that the objection must be allowed to have considerable weight in most of our farm-lanes and bye-ways. The cost, too, of three carts exceeds that of one waggon; the turnpike tolls are greater; and, in harvest, when light yet bulky loads are carried, two horses in a waggon are more effective than the same number in carts. Yet much of these objections to waggons might not only be removed by merely increasing the diameter of the fore-wheels, but by working the wheelers in double shafts; and also by fastening the traces of the leaders either to the axle or to the hinder part of the shafts, in this manner:—

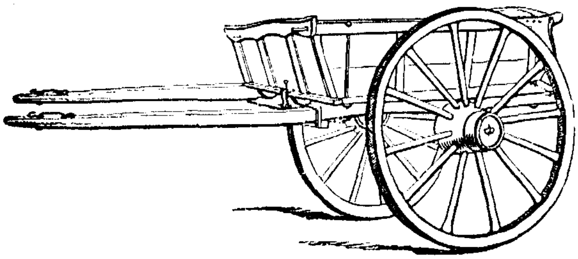


Not only would their direct power upon the draught be thus materially augmented, but the drail, by which they are now commonly attached, being at *a*, it is obvious that, if the thill-horse be taller than the trace-horses, or when they are going down-hill before he has reached the summit, they cannot draw horizontally; whereas, by inserting the trace as above, it would fall to the level of their shoulders, at *b*, and the thill-horse would be spared considerable pressure, which he suffers by their pulling down the ridge-band, *c*, by which the shafts are supported on his back. As to the harnessing the wheelers in double-shafts instead of one before the other, there is little doubt that their power of draught would be thereby so much increased that three horses thus managed might, perhaps, be found nearly equal to four in the common way. But the complaint which has been generally made of the want of knowledge in the application of mechanical principles to the saving of animal labour, among farmers and wheelwrights, has been in this instance very falsely applied, for the narrowness of many of the bye-lanes will not admit of the horses being harnessed in pairs. The conclusion to which these arguments lead is, 'that, upon good roads, and for short distances, with good horses, two-wheeled single-horse carts are the best; but that, with inferior roads and ordinary horses, light four-wheeled waggons, with a team of three or four horses, are the most advantageous*;' to which it may be added, that were broad wheels more generally in use they would be found beneficial to the roads.

Single-horse carts are, however, found so convenient for most kinds of work about a farm, that they are daily becoming more general. They are of every variety of shape and size that such a carriage may be supposed to

* See the Essay on Draught in the Treatise on the Horse, Library of Useful Knowledge, Farmer's Series.

admit, but that which seems most approved is the common *Scotch coup-cart* here delineated :—



	FT.	IN.
Length of the body at bottom . .	5	0
Do. at top	5	6
Breadth of do. at t p	4	4
Do. at bottom . . .	3	10
Depth of do.	3	8
Diameter of the wheels . .	4	6

The buck, or body, is hung upon a pivot, and bolted to the front cross-bar of the frame, so that, on withdrawing the bolt, it may be couped, or thrown back, to discharge the load; and, when occasion requires, it is furnished with a harvest-frame, with which addition it carries a considerable load.

Scotch carts, indeed, contain within the boards somewhat more than a cubic yard, but, when heaped with dung, will carry one yard and three-quarters with ease. They are also generally constructed with superior attention to compactness, lightness, and strength, and the neatness of their appearance, as well as their general usefulness, gives them a striking advantage over the common workmanship of English wheelwrights. Whatever may be thought of the relative use of those carts on a regular-made level road, it has yet been questioned by many intelligent farmers 'whether they can be with propriety recommended for the general home-work of a farm, where roads are commonly bad, and the cart has perhaps to travel over a ploughed field, sinking five or six inches at one place, and impeded by large clods at another*?' Under such circumstances an additional horse seems to be requisite, especially when the weight of the draught sinks the carriage down, and thus lessens the force of the shaft-horse, and renders him unable to get forward. The second horse, if yoked in a line, is then able to do more than the one in the shafts, because, when the cart sinks into the soil, the line of direction of the draught is materially altered †. Mr. Parkinson, who appears to have given both a fair trial, says that he got six carts, which were driven by two men, the usual load being given to each horse, in proportion to what he drew before in a broad-wheeled waggon—nearly a ton, besides the carriage; and the result was, 'that the horses, with the same hours' work and the same food, appeared much injured; the chafing of the cart made their backs sore; and, to keep them in as good condition as when in the waggon, they could not trail more than half their usual burden‡.'

* See the Essay on Draught in the Treatise on the Horse, Library of Useful Knowledge, Farmer's Series.

† Browne, of Markle, Treatise on Rural Affairs, pp. 283, 285, vol. xi.

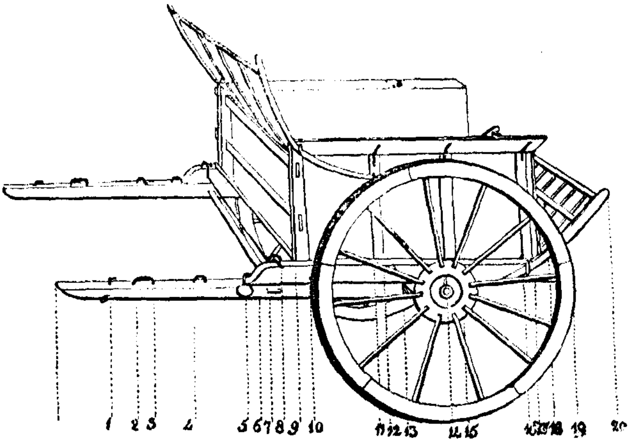
‡ Parkinson on Live Stock, vol. i. p. 186.

There is also a smaller cart, almost exclusively confined to the mere purposes of the farm, the dimensions of which are as follows :—

	FT.	IN.
Inside length of body at top .	4	8
Do. at bottom	4	2
Breadth	3	6
Depth at fore-end . . .	1	2½
Do. at back part . . .	1	½
Diameter of wheels . . .	3	10

Or, in some cases, 4 feet high, 2½ to 3 inches broad, and hooped with nine or ten staves of iron. The sides of the cart are supported by a small bar of iron at each end, and by three intermediate upright stays, or pieces of wood, which are mortised into the top rail, and fixed to the outside of the bottom by iron staples, instead of mortises; by which construction the interior width of the cart is increased. The length of the shafts is 6 feet, and the crooks for drawing by, and those for the horse's stays, are placed upon a large staple in the fore part of the shafts, and between them, on the near-side staple, is one for the back-band. The cost of the whole, complete, will not exceed 8½ guineas; nor that of the larger cart, with a harvest frame of the best materials, more than about 15*l.*

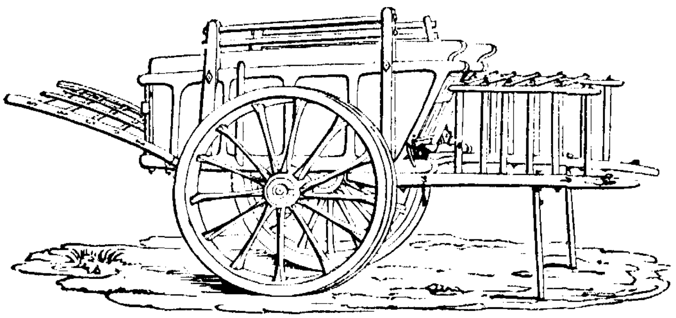
The *Hampshire cart*, which may be used with either one or two horses, is also a very useful carriage. It is of the annexed form and dimensions; the length, from No. 8 to 20, being upon a scale of 11 feet 6 inches. The inside depth, below the raves, which are boarded, is 2 feet, and the projection of the raves 9 inches: the diameter of the wheels is 4 feet 4 inches, and the breadth of the tire from 6 to 9 inches. The whole weight is only 8½ cwt.; it holds 40 bushels; and the ordinary load is 16 cwt. with one horse, and a ton and a half with two *.



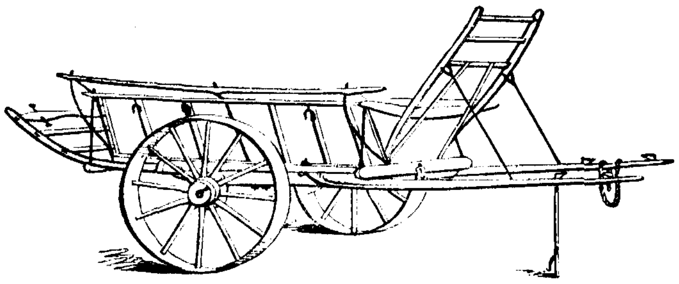
The common *London hay-cart*, for one, two, or three horses, in the following form, is well known, and a more clumsy, ill-constructed vehicle cannot be imagined. With the occasional exception of a waggon, containing an additional half-load, it is the only vehicle used for the conveyance of hay and straw, and the return of dung, round the roads of the metropolis, and seems calculated to carry just a load, consisting of

* Hampshire Report, p. 105.

18 cwt., divided into thirty-six trusses of hay, or the same number of straw, containing 36lbs. each. The weight being light, and occupying a great deal of room, fills up the body of the cart, with the tail and fore ladders and iron arms; and the wheel-horse runs under head-rails. It requires very considerable exactitude in placing so bulky an article with regard to the centre of gravity; but the carters are so habituated to the load, that an accident but rarely occurs. Still, however, a light waggon would be more safe and equally efficient, did not the increased cost of workmanship and turnpikes form objections.



There is also a *two-horse carriage*, which, although called a cart, yet resembles the body of a waggon as nearly as possible, and, in a level country, is useful from its great capacity, containing with ease a load and a half of straw, with two horses. They are used with six-inch wheels, which, as they now appear, are nearly cylindrical.



In Norfolk, and some other parts of the midland counties, they use *tumbrels* for carrying out manure upon their farms. They are 4 feet 3 inches long, by 3 feet 9 inches broad, and 2 feet 3 inches deep; consequently hold full 35 cubical feet: the wheels are 5 feet 6 inches high, and 6 inches broad. The tumbrel does not separate from the shafts in unloading, as in the common mode, but the shafts are fixed, and lift in the air, the trace-horse drawing by the ends of the shafts, and the thill-horse by short traces fixed at the other ends. The heap contains 4½ bushels to a load; but this to two horses, although it appears to the eye, from its heavy construction and lumbering wheels, to be something to draw, is yet nothing but a heavy unmechanical carriage, requiring a team, which one horse would more than draw in a well-contrived single-horse cart *.

* Young's Survey of Norfolk, p. 403.

There is a peculiar sort of cart in use in some large tracts of land, called a *moss-cart*, hich appears to be admirably adapted to the application of marl, or other consolidating substances, to the surface of peaty soils.

	FT.	IN.
Length	5	0
Breadth	4	4
Width	3	10
Height of large wheels . . .	4	4
Do. of the fore-wheel . .	2	9
Breadth of large wheels . . .	0	9
Do. of the small one . .	0	6

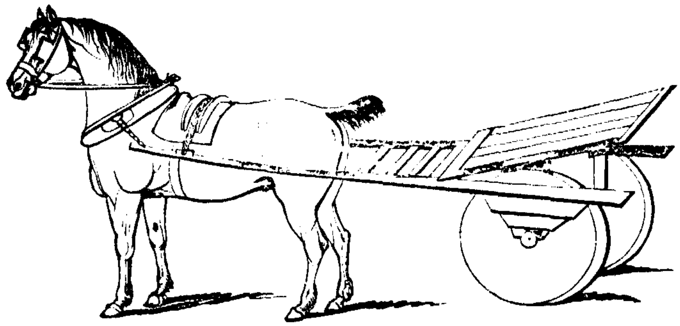
They are all shod with very thin iron, as on moss-lands there can be but little wear; and it is an object of great consequence to have them as light as possible. These carts are capable of being drawn either by two horses abreast, or by the same number at length; for which purpose there are suitable staples fixed for hanging the whipple-tree upon; for it is to be observed that the same traces which are used in a team may be employed here. The frame in which the fore-wheel revolves, and to which the traces are fastened, is exactly the same as in the Norfolk marl-carts, being quite independent of the other wheels, so that it may be turned in any direction.

The horses used in first breaking up and cultivating the moss districts are generally furnished with a kind of *patten*, worn on the hoof to prevent them from sinking into the ground. They are usually made of wood, in a circular form, flat, and fastened on by a small hinge-clasp, as described by Sir John Sinclair *. But the pattens used in the improvements of Chat-moss in Lancashire—which are perhaps preferable—are constructed of alder or elm, and are fixed to the hoof by means of three links and a staple, through each of which passes a leathern strap that goes twice round the hoof, and is fastened by a buckle. The staple is placed behind the patten, which is 10 inches one way, by 10½ the other; the links are about 3 inches in length, and riveted through pieces of hoop-iron, to prevent the wood from splitting †.

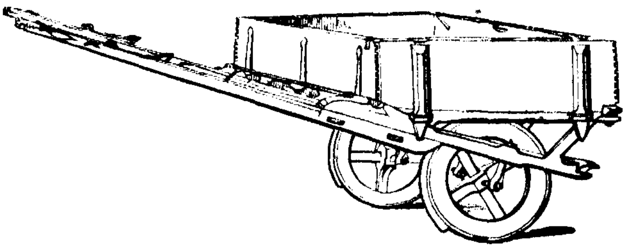
Pattens are not necessary for the fore feet of horses, but are often required for the hind feet, more especially when the moss is first ploughed; for, previous to this invention, the ploughs were wrought by the strength of men, and perhaps a similar contrivance might be of use for oxen, or for horses with bad feet.

The *cars* made use of in Ireland are almost universally drawn by one horse. Scotch carts, with close bodies, or bucks, are indeed creeping in among a few substantial farmers; but the horse in general use, which consists of a serviceable cross-made hack, about 14 hands high, though hardy in constitution, is not well fed enough for strong work, and therefore these slight cars, with their rude appendages of rope and straw harness, suit the poor man better. The cattle, however, are active; and, when put to it to exert themselves, although they draw but little more than 6 cwt., it is surprising how quickly they will clear a harvest-field. The form of the common car is simply that of an oblique platform, raised behind, so as to hold what is there called a *kish*, under the frame of which the wheels, which are composed of three solid blocks, are placed, in the following manner:—

* Communications to the Board of Agriculture, vol. v.
† Dickson's Survey of Lancashire, pp. 181, 183.



And, unless when employed on the roads, when iron is sometimes used, it is only furnished with heavy wooden axletrees. For drawing lime and dung, however, it has sometimes a boarded bottom and sides, and is called a *box-car.* Its cheapness is its principal recommendation, as the cost hardly exceeds 3*l.* or 4*l.*; yet, when made with iron axles and properly-constructed wheels, and furnished with a body, it is not only (on account of its lowness) very easily filled, but, the wheels being placed within the frame, much room is saved in narrow roads; and being besides necessarily cylindrical, and made very broad, it is used with less injury to meadow-ground than common carts. This improved car, therefore,—in the following form,—is not unfrequently found in England: it was preferred in Leicestershire by the late celebrated Bakewell, and it certainly possesses many peculiar advantages.



There is also a very singular, as well as a very useful kind of car, used as a sledge, without wheels, which, though costing only a few shillings, and carrying a load scarcely exceeding 2½ cwt., yet is of great use in the cross-ways of many farms, particularly in mountainous situations.

The body of the *slide-car,* a sketch of which is in the next page, is from *a* to *a* of fig. 1, usually the length of that of the wheel-car, according to the size of the beast: the same may be understood of the breadth. The body is made of oak, or any other timber that may be more convenient. When the shaft of the car is raised to *a* (the supposed height when the horse is yoked at fig. 2), the space *c d* will be found horizontal, or at least will take that direction when the car is at work, particularly when the foot is applied to it. The straps at *b b* are sometimes made of iron, but are most commonly *gads,* made of hazel or sallow, and necessarily require to be frequently replaced in drawing over hard soils. To persons accustomed to

the wheel-cars those on slides must at first view appear awkward, but there are many parts among the bogs and mountains so wholly destitute of practicable roads, that a carriage upon wheels would have no chance, and cannot be so usefully applied as the common slide*.

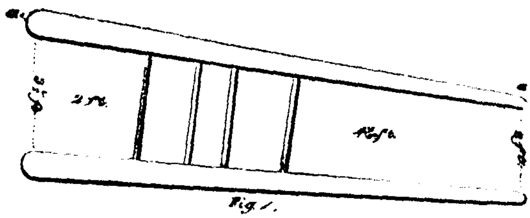


Fig. 1.

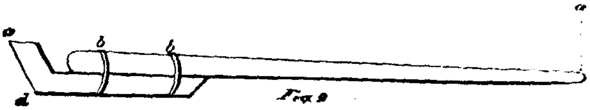


Fig. 2.

These primitive vehicles without wheels are still also in use in many of the mountainous parts of Wales, and in remote districts of the Scottish Highlands, where they may be seen carrying *peats* among the mosses to the nearest point to which they can approach; though, in some places, they have added a pair of low wheels mounted on one end, the sliding part being shod with thick wooden slippers, and the shaft suspended on the horse's back. It has a long body, and carries a tolerably heavy load, considering where it can be used with convenience; though, when they are employed in carrying up manure from the yard to a distant field, the process of tillage is necessarily very tedious. In harvest, however, it is not uncommon to see half a dozen of these carrying from the same field, one party loading the cars in succession; a boy mounted on each horse drives the empty car full speed to the field, another party at the stack-yard receives the loads as they arrive in regular order, and a stranger will hardly credit the celerity with which a large quantity may be carried in a short space of time by this simple method.

There is besides a long and narrow cart of the following dimensions, which is much in use in the provinces, where the bye-roads do not admit of a sufficient length of axletree: they are small and heavy; the wheels in height 4 feet 6 inches; in the buck or boss in length 5 feet 10 inches; the breadth 2 feet 10 inches; and the depth 1 foot 3½ inches: the track of the wheels is 4 feet 3 inches in the clear. It carries only about 16 bushels, and is drawn by a pair of oxen, or by two horses abreast.

For carrying hay, straw, faggots, &c., a kind of car, with a beam, is used, in shape like the cart, but larger, open at each end, and not boarded, and the same pair of wheels do for both, being shifted as occasion may require. It is called *gamboe*, or long-body, and *gurry-butt*, in Devonshire, consisting only of the ground frame of a cart, with four poles, one at each corner, and a small railing on each side, opposite the wheels. A shaft is attached to it for single horses, or a pole for oxen if in yokes. The state of the cross-roads throughout Wales not generally admitting of a greater length of axletree, this gave rise to the formation of conical wheels,

* Tyrone Survey, p. 49.

with bent axletrees, affording a wider space between the top and the bottom of a pair of wheels, so as to admit carriages of wider dimensions to the body upon the same length of axletree. Most of the waggons and carts in modern use have also curved surboards over the wheels, similar to those in several English counties; and the large carts are frequently furnished with double bodies, one with ripples for harvest-work, and the other boarded for coal, lime, or other close loads *. *See* Suppl. Note, No. 8.

The general custom also prevails here, and also in Devonshire and the south-west parts of England, of conveying burdens on the backs of horses, either on pack-saddles, or in a sort of half-round wooden box, called a *dung-pot*, which is very commonly used for carrying out manure in mountainous districts. For carrying corn in the sheaf they likewise employ a willow pannier, which is shaped like a W; the middle rising about 15 inches above the horse's back, and the ends standing 4 or 5 feet apart. There is indeed much resemblance in many practices between those counties and the southern parts of Ireland: the carriage of loads on horses' backs bears sufficient internal evidence of its origin, as it must have preceded the making of regular roads, the adoption of which is still rendered difficult in many retired parts of the country †. These implements can, however, be only regarded as the rude expedients of barbarous ages, which, although rendered necessary through the want of roads, yet have no longer that plea to sanction their continuance in almost any part of the United Kingdom. They are, indeed, fast falling into disuse; and as other obstacles to improvement are removed, they will, no doubt, ere long, be only remembered among the antiquated habits of our forefathers.

STABLE MANAGEMENT.

Notwithstanding that the cost of horses forms a prominent item in the farmer's outlay, there is frequently no part of his live-stock, nor any branch of his business, either so ill understood or so much neglected as *stable management*. Let any one look into the low-roofed, narrow, dark, and unstalled building in which teams are often huddled together in some of the old homesteads, and the fumes arising from stagnant urine lying upon the uneven pavement, as well as from accumulated heaps of fermenting litter, and he must be convinced that it is a place as noxious to health as the cobwebbed rafters, the unwhitewashed walls, and the confusion of the harness and utensils, show it to be devoid of neatness and order. Let him examine the horses, and he will find that, although perhaps sleek from good feeding, their coats are foul and their heels greasy. Instead of exhibiting the sprightly appearance indicated by animals that have been comfortably bedded, their heavy eyes and sluggish appearance distinctly mark the state of the stable they have quitted. But though this description is strictly applicable to many stables, it must yet be admitted that those on most farms of magnitude wear a very different appearance. *See* Sup. N., No. 9.

A stable for farm-horses need not be trigged out like one for hunters; but it should be roomy, clean, and well ventilated, and everything belonging to it should be kept in its proper place. Neither is it necessary that it should be completely stalled: team-cattle are generally quiet—if vicious, they should be got rid of. A pair of horses, worked together, will stand and feed together quite as conveniently as in separate stalls, if allowed sufficient room, and two in one stall are more convenient to the carter. Horses gather their feet under them; and 5 feet, or 4½ feet if the cattle be not

* Surveys of South Wales, vol. i. p. 205—209; North Wales, p. 121.
† Surveys of Cork, p. 249; and of Devon, p. 125.

large, is sufficient width for the fore-quarter. A division between each pair is, however, desirable; but a strong post and rail will be sufficient, without close boarding, provided a partition be made about 4 feet long, and extending from thence upwards at least the full depth of the manger, so as to inclose both that and the rack. Horses, however, sometimes acquire a habit of not lying down at all in the stable, if they be not very conveniently lodged; and as this cannot but prove highly prejudicial to their health, they should, in such cases, be accommodated with roomy single stalls, or else turned out under a loose shed. Double stables, in which horses stand heel to heel, are objectionable; and hay is better when cut fresh daily from the stack, as well as more economically used, than when kept in lofts. Corner racks are preferable to those which extend along the front; and if bars be nailed across the manger, at about a foot distance from each other, they will prevent the horses from throwing out their food, which they are apt to do in search of the corn, when it is mixed with chaff, as well as when they have filled themselves. Every kind of food should also be administered in small quantities at a time: when manger-meat is given, and even when racked up for the night, the provender should be served out sparingly. A cart-horse, fed on dry food, will require from two to three hours to consume his morning feed; the men should therefore be early in the stable, and all food should be punctually given at stated hours. Regularity should also be observed in the hours of their work. A farm-horse can well support ten hours' labour in the day, provided he be not hurried, and the time be divided into two equal periods, with a rest of at least two or three hours between. In the short days of winter, when that cannot be allowed, the time may be prolonged to six or even seven hours, but ought never to extend beyond eight, with a short bait.

Care is also requisite in watering horses in the stable; and it should never be given either immediately before or after their corn, unless they first eat some hay. On the road they may be watered moderately, and then put gently into motion, instead of allowing them to stand at an alehouse door while the carter refreshes himself. Some persons imagine that hard spring-water is the most wholesome for cattle, but horses invariably prefer it soft.

Farm-stables are merely intended to protect the cattle from the weather, for, being much exposed to changes of the temperature, they should never be kept hot; and, as fresh air is an essential element of health, the windows should be merely latticed, like those in granaries, and two or three wooden funnels, according to the size of the stable, should be inserted from the ceiling through the roof, thus forming so many chimneys for the escape of foul vapour. The floors of all stables should be paved with either clinkers or table-stones, laid close and even, and well bedded under the foundation, as otherwise a portion of the urine will be absorbed by the soil, and will emit a nauseous and unwholesome exhalation. The floor should be slightly raised at the front of the stalls; but the slope should not exceed 3 inches, and that should be provided for by raising the litter behind them, or they will stand in an uneasy position. The doors would be more conveniently placed at one end of the stable than in the side, as the dung will be more easily removed, and a free passage may be allowed to the urine by a gentle slant in the gutter of the pavement at their feet, which may then be conveniently carried off by a drain.

Some very intelligent farmers keep their teams entirely in open yards, or *hammels*, surrounded with well-littered sheds for them to run under at

pleasure; and experience has proved that, in this manner, their health may be maintained as well, if not better, than in stables. In the eastern district of Suffolk, horses are seldom permitted to remain in the stable at night, but are turned out when fed in the evening, by which treatment they become hardy, and are neither subject to swelled legs, nor to colds and inflammation*. Such a yard does for the whole year—for summer soiling and winter feeding—but it is attended with the inconvenience of exposing them to accidents when many are thus together; neither can their food be so equally divided, nor can they be kept equally clean†.

Carters have the character of being proverbially thieves—not in the most nefarious sense—but they think it no harm to pilfer corn to pamper their teams: they have no idea of any better mode of feeding than to cram them to the utmost, and, if allowed the free use of hay, they will not only waste it, but, out of mistaken kindness, do the animals serious injury by overloading their stomachs. On every consideration, therefore, of health and economy, they should be allowanced. The chaff, as well as the corn, should be weighed, or measured‡, and if hay be given in the racks, it should be bound, and given out in trusses: the expense of binding will be more than repaid by the saving in consumption. Marshall has justly observed in his Minutes of Agriculture, that, by stinting the quantity, the men become more careful; they look upon it as something, and know that, if they lavish to-day, they will want to-morrow; thus the servant learns frugality, while his cattle have their food regularly: he will give them a little at a time, and see that they eat it up clean. There is a sympathy between the human and the brute creation, arising from acquaintance, which is more easily observed than communicated. There are carters who would sooner starve themselves than their horses, and among stock-feeders in general, it is obvious to common observation; though this kindness does not extend equally to the bestowal of their labour, and, from habit, as well as idleness, they are very generally neglectful of the essential duties of cleanliness. Much of this must, however, be attributed to their masters, who too commonly treat them as men not to be trusted, and suspicion naturally begets deceit. There is, consequently, but little sympathy existing between them; but when servants are used with kindness, they often return it with interest, and devote themselves with sincerity to the service of their employer.

Condition is a word of large meaning in the stable of a gentleman; in that of a farmer, whose horses should be kept more for work than for show, it should be understood to mean a sufficiency of wholesome food, evidenced by a healthy, mellow, clean-skinned hide, without much fat,—a lively eye, and a general appearance of health. Common working horses require but little grooming; yet their coats should be kept clear of scurf, and their feet should be well attended to. The rough hair which encumbers their fetlocks is useful in some countries as a protection against flints, but a much less quantity would serve that purpose, and when allowed to remain clogged with dirt, it engenders grease. Through a very unwise economy of some masters, the shoes, too, are seldom removed until they are either completely worn or broken, by which much injury is done to the hoof; their shoulders are galled by want of timely attention to the state of the collars; and time is continually lost by the breaking and patching of the harness. In all these cases prevention is better than cure; and, besides the established

* Suffolk Report, p. 219; Oxfordshire do., p. 283.

† See also the plans of Cattle-sheds in the following chapter.

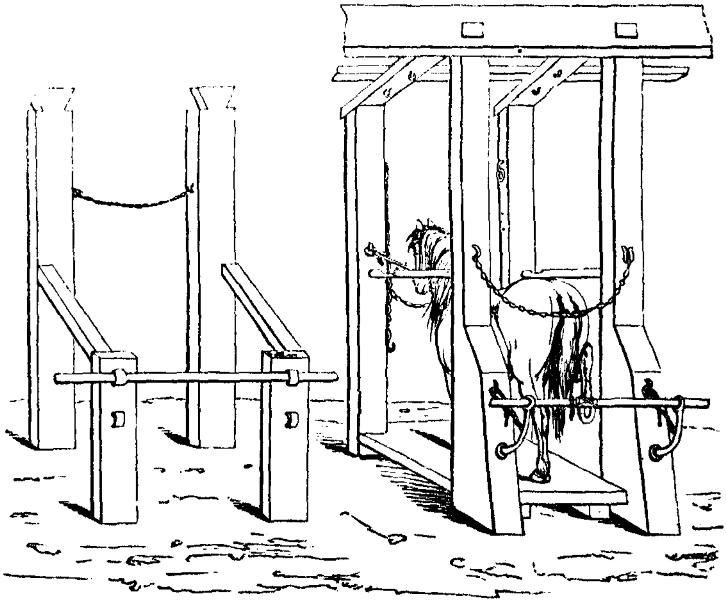
‡ From 5½lbs. to 6lbs. of short-cut chaff, exclusive of corn, fill a bushel measure.

regulation of removing the dung and 'setting the stable fair' every morning, as well as seeing that each horse be thoroughly dry and clean, his feet washed, and occasionally oiled and stopped, before 'making up for the night,'—it would be a good rule to have a regular inspection of the cattle, harness, and implements, once every week, even were a portion of the Saturday evening's usual work devoted to that purpose.

SHOEING.

Although the better class of veterinary surgeons are now men of considerable education, possessing science of inestimable service to the animals placed under their care, it is yet to be regretted that the common run of farriers are men of a very different description, who, though usually employed in common cases, yet should never be entrusted in one that incurs danger. They, however, are generally handy workmen, and possessed of knowledge and observation sufficient to shoe a horse with propriety, though it is often an operation which requires considerable delicacy, and, in the commonest case, should never be confided to a man who is not perfectly master of his business. Though usually executed, through the general docility of the animals, without any extraordinary difficulty, yet there is no one who has not witnessed repeated instances of accidents to both men and horses, through the violence or the imperfect performance of the operation, through the unsteadiness of the latter; and it even sometimes becomes necessary to cast them, in order to avoid danger, from the want of a proper machine for the purpose of security.

This difficulty may, however, be avoided by the adoption of the Flemish forge, which is in general use throughout the Low Countries, and consists of strong posts and rails, by which the horses are confined in a very simple apparatus, which may be easily erected, and which we partly copy from one of the plates in the work of Count Lasteyrie on agricultural implements *.



* Collection de Machines employées dans l'Economie Rurale, par le Comte de Lasteyrie, tome ii. Animaux, planche 11, fig. 2 and 3.

Fig. 1 consists merely of four upright posts, joined by lateral rails, between which the horse is placed; he is then fastened by cords at the head, and there is a moveable bar across the two lower posts, which runs through the rings placed between them, while the hoof can be securely poised upon the bar, and strapped, without danger to the smith.

Fig. 2 is nearly similar; but the transverse bar is there fixed upon pivots, which allow it to be moved up and down to alter its position, and is certainly an improvement. Should the horse be very vicious, he can be raised from the ground by means of a cradle, slung with strong girth web from one side of the upper side-rails, and hooked on to the other; and in that mode the preparation of the hoof, or any other operation, proceeds securely and quietly.

There is a more complex machine in Mr. Radcliff's work on the Agriculture of Flanders; and he adds, in his account of shoeing, that, 'Whether it be due to this uninterrupted driving of the nails, or to the form in which they are moulded and countersunk, or to the toughness of the iron of which they are composed, or to all those circumstances combined, that the shoes hold on longer than with us, the fact is so, as experience testifies, and the habit of the country confirms; two months being the regular interval for shoeing such horses as are used upon the pavement, and still longer time for those employed merely upon the farms. In the latter case, indeed, the hinder feet are in many instances left unshod—a species of economy which, not being injurious to the animal in a soil free from gravel and stones, is perfectly admissible *.'

BREED.

There are three distinctive *breeds of horses* peculiarly appropriated to farm-work in England—the *Lincoln*, the *Cleveland*, and the *Suffolk*; each of which has its peculiar merits. The first, which is chiefly bred in the county from which it takes its name, is the old English black cart-horse, improved by crossing with some Dutch and Friesland mares; a slow animal, of great power, and well adapted, by its weight, as well as strength, to draw heavy loads. It may be seen in the plough, drawn by four horses of length, and exciting the ridicule of some other farmers; but these are chiefly young cattle, being trained for work, and only gently broken in. They thus gain a good part of their support, and are afterwards sold at high prices to the London waggoners and brewers' draymen, and are, without any doubt, the finest breed of that kind of animal in the kingdom. It must, however, be admitted that, in numberless instances, attention has been more directed to procure fine-looking cattle than really useful animals for farm purposes. Large, heavy-heeled, black horses have been long the fashion, and there are undoubtedly many situations where the heaviness of the roads and the severity of the work require more than ordinary strength; but great horses not only cost proportionably more at first than those of more moderate size, but require much more and better food to keep up their flesh. The pride of a farmer in buying such horses is followed by the pride of his carter in keeping them as fat as possible; and as they are very commonly fed without any account being kept, the cost is seldom accurately known. There can be no doubt that, in Lincolnshire and some of the neighbouring counties, there are some farmers who breed that heavy stock with considerable profit. With men who understand it as a business,

* Rev. Thomas Radcliff on the Agriculture of East and West Flanders, with two plates, p. 219. See also the description (with an engraving) of an improved forge, in vol. iii. of the Transactions of the Highland Society.

and make a trade of it, it may answer; and a farmer who has the convenience of pasture for young horses will find a certain advantage in keeping up his working cattle with a few mares; for, although there may not be any real saving in the plan, yet the expense comes imperceptibly out of his pocket, and he is not called upon at once for a heavy sum to replenish his stock. But the notion of buying colts with the intention of nursing them, and then selling them to the London tradesmen, though large prices are sometimes thus obtained, will seldom be found a profitable speculation to any other than dealers. Farmers keep them under the idea that they earn their support during the whole period of their growth, and that the increase of price is entirely profit; but that is certainly a mistake, for those large horses rarely come to perfection until five or six years old, during the whole of which time they must be treated with more tenderness than will be repaid by their work, or they will suffer accordingly in their market value. For the farmer's real use, on any moderately light land, and without being encumbered with the distant carriage of lime, or other extraordinarily heavy work, the smaller and more active kind of horses will be found not only to step quicker, and to bear fatigue better, but also to keep up their flesh with proportionably less food, and with that too of an inferior quality.

The *Cleveland Bays*, as they are usually called from the prevalence of the colour, as well as from the district in which they were originally bred, are found in every part of Yorkshire and the neighbouring counties: they measure from sixteen to seventeen hands, carry a fine forehand, with a considerable show of blood, are active, powerful, and well suited to the general purposes of agriculture. They were the origin of our best kind of heavy coach-horse, but the breed is fast wearing out in consequence of the crosses made with a view to improve their speed. Still, however, they retain much of their ancient merit, and they possess a particular value in the estimation of those farmers who occasionally use their plough-horses for the taxed cart or the saddle. Since the introduction of whip-reins in the improved system of agriculture, the advantage of an active team, in many pressing operations of husbandry, has been more fully appreciated than formerly; and even in ploughing a quick step is of more importance than may be generally imagined. It is only, therefore, for heavy road-work, where the motion is unusually slow, and the weight of the animal constitutes a portion of its power, that the bulky slow-paced cattle commonly employed in waggons will be found so useful for all purposes as horses of a more compact form.

The *Suffolk Punch* is, as its name indicates, a large horse in a small compass, rarely exceeding, and generally under, fifteen hands and a half, and possessed of most of the points that distinguish a good draught horse—straight-backed, broad and arched across the loins, with short couples, full and lengthy quarters, sinewy fore-arms, and an open chest, the shoulder low, but well set for the collar; though wanting depth in the chest, and coarse headed. Horses of this breed are both strong and active, and in general request in the southern counties, where they are considered superior to every other for the farmer's use. Some good *cobs* have been obtained from them; but it is to be regretted that, in the rage which existed some years ago for improvement in all kinds of stock, the original breed was so much crossed, that one of the genuine race can seldom be found, except it be in colour, which is generally chestnut. A taller and finer shouldered horse has been produced, but he is more leggy, less compact, and does not stand so well to collar. In the latter quality, so essential in a draught

horse, the old kind were unrivalled: they were proverbially 'honest pullers,' and they not only drew weights that seemed utterly disproportioned to their size, but they exerted themselves with all the spirit of thorough-bred cattle, rarely giving in until their strength was entirely exhausted. Those of the genuine stock have now become scarce; but as some of pure blood have been preserved by a few men who knew their value, and were satisfied to retain it unalloyed, as well as unimproved, it is to be hoped that the breed will not be entirely lost.

The *Clydesdale* are mostly reared in Lanarkshire, or, more properly, in every part of the south of Scotland, and are deservedly favourites throughout the north, from their docility and steadiness: they are of all colours. neither so handsome nor so active as the Cleveland, but stronger, more patient, and perhaps better suited to heavy land, than that or the Suffolk.

There is a story—which, however, has been refuted—that the Clydesdale horse owes its origin to one of the Dukes of Hamilton, who crossed some of the best Lanarkshire mares with stallions which he had over from Flanders, two centuries ago; nor, except as a history of any particular breed may be an object of curiosity, is it matter of much interest, though it has occasioned considerable discussion. The stock appears to be an ancient race, improved by better keep than common about the middle of the last century, and is fully entitled to strong commendation. The mode of treating them does not differ materially from what is observed in the best breeds in other districts. Mares are kept at moderate work until within a short period of foaling, and the foals are weaned about the end of October. They are then kept under cool sheds, and put to grass during the second summer; and from that, until they arrive at full growth, they are gently treated and lightly loaded. They get a quantity of corn in proportion to their work—from half a peck to a peck daily for farm-work, and more if hard wrought. Many of the coal-drivers who ply about the towns for hire, however, feed their horses, it is said, to the extent of a bushel of oats, or beans of equal value, daily: the weight which these animals draw is perhaps the severest labour in Scotland, the cartage—30 cwt. besides the cart—being considered no more than the ordinary work of a single horse, sometimes travelling regularly upwards of twenty miles a day. Farmers sometimes feed them partly on potatoes, but carrots are thought better, or a small portion of linseed, either oil or cake, given once a day in steamed food, would be a great improvement, as it is not only nutritious, but softens their bowels, and tends to prevent inflammation.

It seems that a warm sensation has been created among the breeders, in consequence of a novel restriction at a late great cattle-show at Glasgow, prohibiting the presentation of prizes to draught-horses with white legs or feet; and it appears that, on that occasion, no animal was exhibited coming within the exception. This, doubtless, is an imperfection, for, although a good horse is always of good colour, yet it is well known that white hooves are more tender, and somewhat more liable to accident, than black ones, and that, in the opinion of good judges, they will not fetch so much money *.

The native *Irish garron* is mostly bred in the mountains. He is about fourteen hands high, light-limbed, but cat-hammed and low in the shoulder, yet short-legged, with close pasterns, and very sure-footed. He is also hardy and indefatigable, and, though supported upon the worst of fare, he

* See Mr. Aiton on the Lanarkshire Horses, in No. XV. of the British Farmer's Magazine, May 1830; and also another article, in the Quarterly Journal of Agriculture for November 1828, by Mr. Wallace, of Kelly.

makes a capital roadster. As the carriages for the conveyance of goods are light, the weight of a horse, after a certain size, is thought to tire him, and both the quantity and the quality of his food form matter for serious consideration. Such are the reasons assigned for continuing the breed, and it must be admitted that the efforts made of late years to improve it have been far from successful. Nothing can be more wretched than the animals to be seen ploughing on most of the farms; and they are generally harnessed with ropes, and collars of straw, or *gads*.

Almost every farmer who occupies so much as 100 acres of tillage keeps one or two mares which he breeds from, and works to within a fortnight of the time for dropping their foals. These colts he either sells at three years old, or employs them in his own team; but the only qualification that is thought of, regarding the stock, is the size of the sire and the price of covering, which is seldom allowed to exceed three half-crowns, or, at the most, half a barrel of oats. This of course prevents improvement; another cause also arises from their crossing with shambling blood horses, which produce an awkward race of mongrels, and are ever sure to disappoint the expectations of the breeder. The introduction of well-proportioned stallions, of a moderate compact size, would produce cattle adapted to the cars of the country, and better suited to the purpose than tall leggy horses, or even to thorough-bred waggon-cattle, which are too large. Some improvement has however been made in the north by a cross with the Galloway breed, which is stoutly built, somewhat between the saddle and the cart kind, and seems to agree well with hard work, besides being easily maintained. He appears clumsy from the roughness of his coat, which seldom enjoys the comfort of a roof; but he is a well-formed animal, with great strength of sinew, and, when tolerably kept, is capable of enduring great fatigue.

Next to early working and bad feeding, the bad breaking-in of horses is to be complained of. In this branch there is not any pains taken by the generality of farmers: the most usual way is, when the horse is three years old, to put him to the harrow, and, should he prove spirited, to work him down; if sulky or stubborn, to flog him unmercifully, often about the head, and gentler means are seldom tried. Thus his temper is ruined by ill treatment, and the animal grows vicious, when with proper usage he would exert every nerve in the service of his master. Young horses should be coaxed into their work. If gentle means fail, harsher means may be tried; but still with temper; for with nine horses in ten, gentleness succeeds better than severity *.

The best mode of training them for farm-work is, after having accustomed them to be handled, to place them in the plough along with a steady old horse, and under the care of a well-disposed and intelligent ploughman. They may be brought into use when two years old off, or in the course of that summer; but they must be very moderately worked, and only in half-days at a time, for they cannot support greater exertion until they have reached their fourth year. They will then, by gradually increasing their labour, be brought to the full extent of their powers, and their strength may be fully employed without injury, provided they be not called upon to exert it by hurrying their speed: a working horse will rarely suffer by any fairly-managed labour, if it be slowly executed, or at least without any material increase of the natural walking-pace.

Breeding is so peculiarly a matter of taste, that we shall only observe that

* On this and the preceding paragraphs respecting Irish horses, see the Surveys of Meath, p. 326; Antrim, p. 177; Cavan, p. 74; Down, p. 263; Wicklow, p. 249; Cork, p. 282; Kildare, p. 127; Kilkenny, p. 305.

great speed and power. There is also a race of Arabian origin, which is chiefly used for the saddle; and those reared at the island of Gozo, in the Mediterranean,—a few of which have been brought to this country, as stallions for the production of mules,—have reached the height of fourteen hands, and have been sold for the sum of 100 guineas.

Asses are surprisingly little employed by farmers, considering their use and economy, for they are supported by the worthless pickings of lanes and bye-ways, or the scanty refuse of other cattle; and yet they carry heavy loads, and might be made very serviceable in the supply of green food to stall-fed beasts and working stock, as well as in carrying off the weeds from fields when under the hoe; all which might be done with children as drivers, and panniers made to let the load down at bottom. The saving of food by weeding may not amount to much in a money calculation, though many herbs thus thrown away would be found palatable if gathered for cattle; but were these animals only employed to remove the weeds from the ground when hoed, it would be of great service, for at least one half of them strike root again after the first shower, and the remainder, if not eaten, is lost to the dung-heap, whereas that loss would be prevented were they raked up and collected. Their drivers also would be kept employed, which would be found very serviceable to the poor, not alone as an addition, however trifling, to their earnings, but as bringing them up in habits of industry, and as early initiating them into the care of domestic animals, by which their kindness and attention to brutes is found to be very much improved. This is so remarkable in France, Spain, and Switzerland, that sheep and oxen regularly follow their keepers to the field, instead of being driven; and the peasantry, being more accustomed in their childhood to attendance upon animals, in consequence of the general want of inclosures, soon learn to treat them with tenderness and familiarity, which is returned by the increased docility and the improved condition of their charge.

CHAPTER VIII.

ANIMAL LABOUR—OX-TEAMS—TRAINING AND MANAGEMENT—COMPARATIVE VIEW OF HORSES AND OXEN AS BEASTS OF DRAUGHT.

In ancient times, while agriculture, yet in its infancy, was confined to the mere production of corn, and most farms possessed a right to a large share of common pasture on adjoining land, then uninclosed,—oxen were the only cattle employed in tillage in this country, and are so still throughout the greater part of Europe. They sufficed for labour which went slowly on under a system of alternate crop and fallow; there was but little intercourse with markets; extraneous manures, to be drawn from a great distance, were not thought of; and they were maintained at little expense on grass in summer, and on straw during the winter, until the time arrived when, being no longer fit for work, they were consigned to the shambles. It is even doubtful whether the land then under cultivation, and under the defective management of that period, would have supported the requisite

number of horse-teams for tillage, and of oxen for food. We must not, therefore, wonder at the eulogium of old Fitzherbert, when he tells us—'therefore me seemeth, all thynges considered, the ploughe of oxen is muche more profitable than the ploughe of horses *.' But after the introduction of the artificial grasses, and the adoption of turnips, potatoes, and other esculent roots, into field culture, a new era dawned upon the husbandman: the fields, which formerly lay idle until they recovered from previous exhaustion, were applied to the production of green crops, which, by feeding an additional number of cattle, created manure to keep them in heart. As the fertilizing properties of lime and other substances became more generally known, they were more extensively applied to the soil: the drill and horse-hoeing system in a great degree superseded the former fallow; and these improvements demanding more active exertion than was suited to heavy teams of oxen, while the employment of horses was no longer prevented by deficiency of fodder, the former gradually fell into disuse.

Other considerations also contributed to this change. On some soils the breeding of sheep was found more profitable, under the new system, than oxen; the weaker kinds of the latter were no longer fit for the labour required of them, and the coarse pastures on which they were reared were daily brought under the plough. Efforts, too, were made to improve the breed of horses, while that of black cattle was comparatively neglected: bone and strength, then deemed synonimous, were the points chiefly regarded both for the saddle and for draught; and many good hunters of former days, as well as most of the coach-horses, were bred out of cart-mares, crossed with three-parts, or sometimes thorough-bred, stallions. Such was the origin of the famous Cleveland race, and farmers found their account in keeping teams of mares, from which they bred, while they at the same time employed them in field-labour. The business of the grazier, which had hitherto been confined to the rich feeding districts, now likewise obtained a wider range: the demand for fatting stock was enlarged, and it was generally found more profitable to fatten those which were not peculiarly adapted to labour while young, than to keep them for the plough. Fashion, too, had its share in the innovation. The sluggishness of the ox-team, and the uncouthness of the yoke and goad, when compared with the spirit of the horse, the gayer harness, and the whalebone whip, rendered them despicable in the eyes of the ploughman and carter; and it has been shrewdly observed, by one well qualified to judge, that, howsoever trivial this observation may appear to the inexperienced in farming, their influence has conduced, more than any other cause, to the disrepute of oxen †. But, above all, the evident economy and convenience of the pair-horse plough, when contrasted with cumbersome teams of four oxen and a driver, could hardly fail to exclude them.

Oxen, however, still partially maintain their ground as beasts of draught in some counties—as Sussex, Devon and its neighbourhood, Glamorgan, and Hereford, which have been long in possession of a superior working stock; the different breeds having of late years also attracted much attention, and been greatly improved, and many amateur gentlemen-farmers and theoretic writers having recommended their use in preference to horses, upon grounds of political, as well as private economy, their superiority has been keenly contested. The arguments in favour of each, so far as they affect the farmer, may be thus stated:—

* Booke of Husbandrie, ann. 1523, p. 66.

† Marshall, Minutes of Agriculture, Digest, p. 48.

That oxen are supported at less expense of food, farriery, and harness, are less subject to casualties, and require less attendance than horses; that they are more steady at heavy draught, and perform more work in proportion to their annual cost; and that they increase in value while working, and are at last worth more than at first; while the horse declines in value, and is at length sold for his skin. But then—

That horses, though more expensive, yet perform their work better and more expeditiously; that if oxen are more steady, they are also less active, less fit to encounter bad roads or extremes of weather, less capable of making any extraordinary exertion, less tractable, and consequently less generally useful than horses; and that their increase in value arises from their being only worked a few years, and then sold; while horses are worked out, but, if sold at the same age, would be most profitable.

These opposite assertions have been severally supported by numberless statements, the greater part of which, being founded upon assumed data, are entitled to but little attention: even comparative trials, unless made during a long successive period, by experienced and unprejudiced persons, cannot command entire confidence. Were any similar number of horses and oxen, proportionally equal in point of strength, breed, and condition, worked together, during an entire year, on two pieces of ground of the same size and quality, and under one rotation,—and were an exact register kept of their feeding, farriery, attendance, and labour, together with weekly remarks on their performance, and a separate account of the crops reaped from each piece,—then a fair comparison might be drawn between their qualities as working cattle; and a final account, of first cost and sale, would show their respective value as stock. But nothing can be more vague and inconclusive, even when they are impartial, than the generality of accounts which have been published. We hear continually of an acre a day being ploughed by a pair of oxen, but we are seldom told the length of time such work has been continued, nor in what manner it has been executed, though so much depends upon the size of the furrow, as well as the state of the land, that without those particulars no accurate idea of it can be formed: neither do we learn anything of the mode in which they are fed, though the main question—the profit or loss—turns upon that hinge.

The very general disuse of oxen might be thought an unanswerable proof of their inferiority to horses for farm labour; and indeed there are few subjects on which most practical men, especially in Scotland, are more fully agreed. But the seasons are there so backward, and they are so liable to interruption through the changeableness of the climate at seed-time and harvest, that unusual efforts are often necessary, in which case there is this material difference between horses and oxen—that the former, though jaded, will yet exert themselves if urged, and with higher feeding are capable of much extra labour, whereas, no increase of food will, in an equal degree, improve the mettle of the ox: if once thoroughly fatigued, he will lie down in his harness, and the goad can neither compel him to mend his pace while he works, nor force him to continue it when he tires; or, if over-worked, he is seriously injured. In this country, however, the same pressure of work does not so often occur; there is, besides, a greater extent of pasture usually attached to our arable farms than to those of the Scottish lowlands, consequently more convenience for cattle; and our common breeds are better adapted to the plough than the highland stock. The question, too, has assumed a new character since the practicability

has been shown of working oxen in single pairs, with whip and reins, which has removed much of the prejudice against them *, and the expediency of employing them, at least in part, is still undecided. In whatever way it may be viewed, the subject is important, and a brief summary of some facts, which rest on undoubted authority, will, better than any speculative reasoning, assist the judgment in arriving at a just conclusion.

In several ploughing-matches recorded by the Bath Agricultural Society, oxen seem to have done the work nearly as well as horses; and in one very decisive contest, at Warminster, in which seven ploughs started, two drawn by oxen and the rest by horses, all in pairs and without drivers, the first prize was awarded to an ox-team, 'as the cheapest and the best †.' Similar results are said to have arisen from trials before the Dublin Society, and at Burnham Wick, in Essex, in each of which, several ploughs drawn by the oxen of the country, in pairs only and without drivers, actually beat the horses in the former instance, and in the latter, performed the task within a quarter of an hour of picked horse-teams, which in that county were probably composed of the Suffolk punch ‡. In none of these trials, however, is the breed of either kind of cattle noted with sufficient accuracy for a decisive comparison; nor do they prove more than the capability of oxen to go through one good day's work: the power of continuing it is a point of more importance, and on that we have the evidence of the late Lord Somerville, who stated his regular work to have been 'at the rate of 80 acres of tillage to four oxen; and that twelve oxen worked 30 acres of land per week, when not employed in carriage of lime or manure, which is 10 acres per week for each four oxen, or 5 acres for each pair; that is, 2 acres per day for five days in the week for each team of four, leaving them two resting days: their day's work was done in seven hours and a half, and if corn was allowed them, they would probably do more §.' In a following year, his Lordship adds, that, notwithstanding his cattle were, in consequence of the failure of the green crops, put to straw and hay in the beginning of September, yet that, from the 1st of January following to some time in May, sixteen oxen and steers, a proportion of which were too young to do much, ploughed 237 acres in a hilly country, and were yet in very good condition, and even high in flesh. It should, however, be observed, that the soil is described as a fine free-working loam; that 105 acres were second ploughings; and that, as the whole work was preparatory to barley, peas, and turnip-fallow, probably no part of the ground was broken up from a ley. A jobbing horse was also allowed to every 100 acres. The same publication also contains an authenticated account of two pairs of large oxen belonging to Sir Thomas Carmichael, of Skirling, in Peeblesshire, which had been worked regularly during five years, along with horses, on one of the most hilly arable farms in the county, and had performed every kind of labour—pair for pair—with perfect equality. They, however, had an allowance of oats during five months of the year, with nearly an acre of turnips each ox; and the kind of horses employed is not specified ¶.

Other well-authenticated instances, to nearly the same effect, occur in

* See Findlater's Survey of Peeblesshire; and a letter from that gentleman, in the Farmer's Magazine (No. 53), subsequently retracting his objections.

† Papers of the Bath and West of England Society, vol. xiii. art. xxi. See also vol. xii. art. vi. and xiv., and the Introduction to vol. iv. p. xxv.

‡ Letter from Lord Somerville, Farmer's Magazine, vol. iv. p. 343.

§ Ibid., p. 344.

‖ Letter from Lord Somerville, Farmer's Magazine, vol. vi. pp. 4—6.

¶ Ibid., vol. xiv. p. 41.

the County Surveys. In that of Leicestershire, a farm is mentioned of 100 acres of arable, and 60 of pasture and wood land, the whole work of which, including statute-labour and the carriage of timber, is performed by six oxen working in pairs*. In like manner, a farm of 100 acres, in Sherwood Forest, is described as entirely cultivated by four oxen, fed wholly on grass and straw, which plough an acre a day, working alternately, one pair in the morning and the other in the afternoon†. The soil of either is not mentioned; but, judging from the proportion of wood and pasture in the one, and the situation of the other, both are probably light land. In some parts of Yorkshire, five, and in Hertfordshire six oxen, are considered equal to four horses ‡. In Gloucestershire, a team of five Hereford oxen, fed on grass and hay, is also reported to have been rather superior to four stout able horses employed twice a week on heavy road-work, to the distance of fourteen miles and back; and another of four to have performed as much farm-labour as any horse-team in the same parish §, although, in their own county, four are only considered equal to three horses ||. Nearly similar replies, with some reservation as to harvest-work, were given to inquiries in Norfolk and some other counties ¶; but in Cornwall, where, as well as in Devonshire, they are very universally used, they are described as 'going at a full trot with the empty carriages in the bustling seasons of hay-time and harvest**.' In the Sussex Report, Lord Sheffield's oxen are said to step out better and faster than horses, and to do the same work on an extensive farm, though they never have any food but grass or straw until they begin to work hard in the spring, when they have hay cut with their straw; and Mr. Young affirms, from actual observation, 'that two Sussex oxen, in harness, will plough daily an acre of strong land with as much ease as two horses ††.'

In opposition to this, however, the Middlesex Report states that four fine Sussex oxen, and afterwards four out of Pembrokeshire, of a lighter breed, could not keep on work regularly against a team of horses, although fed without limitation on clover-hay. It also represents two pairs of stout oxen—the one eight, and the other four years old—drawing two of Small's ploughs, and turning a furrow of 11 inches wide, by, on an average, 3½ deep, as only ploughing a fallow at the rate of 2 roods and 16 perches in nearly eight hours, or little more than 3½ acres a week. The soil, indeed, was a very tenacious loam, on a yellow clay, and worked very tough; but it was free of stones: yet the work was so much too severe that the younger pair gave in; and the ploughman gave as a reason for taking so broad a furrow, 'that they should otherwise do almost nothing, as the oxen would not bear being driven much faster ‡‡.' Mr. Middleton, indeed, considers them in every respect inferior to horses, an opinion which is confirmed both by Brown of Markle and Parkinson §§. Mr. Frost, too, bailiff to his late Majesty George III., who had more opportunity than

* Leicestershire Report, p. 241. † Notts. Rep., p. 130.

‡ Tuke's Survey of the North Riding of Yorkshire, p. 281. Herts. Report, chap. xiii. sect. iv.

§ Rudge's Survey of Gloucestershire, p. 319. || Hereford Report, p. 129.

¶ Young's Reports of Norfolk, p. 481; of Herts., p. 200; of Essex, vol. ii. p. 357; and of Oxfordshire, p. 287—295. Shropshire Report, p. 264.

** Cornwall Report, p. 146.

†† Sussex Survey (the *Rev.* Arthur Young's—not the Secretary to the Board of Agriculture), pp. 382 and 446.

‡‡ Middleton's Survey of Middlesex, pp. 482, 483, 2nd edit.

§§ Brown's Treatise on Agriculture and Rural Affairs, vol. ii. chap. x. sect. v. Parkinson's Treatise on Live Stock, vol. i. chap. i. sect. xviii.

most men of judging, though a warm advocate for ox-teams, yet admits that the work of one hundred and seven oxen on the Windsor farms might have been performed by sixty-five horses *. Messrs. Culley, and many other extensive farmers in different counties, who at one time employed oxen very extensively, yet afterwards relinquished them; and Mr. Pitt, the intelligent surveyor of Staffordshire, only estimates them as three to two in comparison with horses, on light land, and as two to one on heavy soils: 'nor hardly in that proportion without good care and keep in the winter †

It is difficult to reconcile such conflicting facts and opinions; but, even supposing oxen to be equal to horses for all purposes of farm-labour, still the expediency of preferring them must depend upon the cost of their maintenance, and it must be borne in mind that, if hard-worked, their value to the grazier will be proportionally diminished. The profit attending them depends, in fact, upon two objects in a great measure incompatible with each other—*labour* and *flesh*: keeping both in view, an ox ought always to be *beef*, which he cannot be if constantly worked, unless he be highly fed; for if the grazing part of the business is to turn to profit, the animal must not be impeded in his thriving and growth by severe labour, which would destroy the supposed advantage of his increase in value and of cheaper keep. Looking, therefore, both to present use and ultimate sale, experience has proved that four oxen should be employed to perform the work of two horses; and this, however it may be contradicted by particular instances, is most conformable to general practice: the comparative expense of each team, in that proportion, must therefore decide the superior value of either.

An account published by the late Mr. Billingsley, whose accuracy few will dispute who are acquainted with his character as a farmer, shows that eight long-horned oxen, kept as a plough-team on a farm in an exposed situation on the Mendip Hills, and worked in a double-furrowed plough, six together at a time, ploughed 385 acres, and harrowed 291, chiefly with heavy drags, within eleven months; the average breadth of the furrow being from 7 to 10, and the depth from 3 to 5 inches; and the plough generally turned 2½ acres in eight hours. Mr. Billingsley adopted the unusual plan of paying his ploughman by the acre, at the rate of 1*s*. 4*d*. for each ploughing, and 6*d*. for each harrowing, for himself and his boy, by which they earned nearly 14*s*. a week; and the whole expense, exclusive of straw, for which the dung was, no doubt, deemed an equivalent, is stated to have been—

				£.	s.	d.
8 OXEN, hay from Jan. 1 to May 15, 19 weeks, 1 ton per week—19 tons, at 50*s*.				47	10	0
24 weeks grass, at 3*s*. per week each				28	16	0
6 tons of hay in Oct. and Nov., at 50*s*.				15	0	0
Repair of yokes and bows				0	18	0
Wear of ploughs, chains, &c.				4	13	6
385 acres ploughing, at 1*s*. 4*d*.	25	13	4			
291 „ harrowing, at 6*d*.	7	5	6			
				32	18	10
				129	16	4‡

This, which leaves the ploughings at about 5*s*. an acre, at first sight

* Mavor's Survey of Berkshire, p. 310.

† Stafford Report, p. 149. See also the Surveys of Kent, 2nd edit. chap. xiii. sect. iii.; and of Lancashire, chap. xiv. sect. iii.

‡ Bath and West of England Society's Papers, vol. x. art. vi.

appears much in favour of oxen; but on closer examination it will be found that, were hay charged at the same rate as in the previous estimate of the expense of a horse-team,—namely 65*s.* per ton—and the soiling and pasturage at the same sum per head, without any charge for straw, the cost of feeding eight oxen during the same time would exceed that of four horses: then, supposing them to be purchased for the same sum, to be worked at the same charge for wages and wear of implements; and allowing 40*s.* each to be added annually to the value of each ox, and deducted from that of the horses—though if fatting stock be properly managed, this difference in the price of oxen, though commonly calculated, may be yet fairly doubted—the difference will appear to be—

	£.	s.	d.	£.	s.	d.
8 Oxen, Summering at 5*l.* 5*s.* each .	42	0	0			
25 tons of hay, at 65*s.* per ton .	81	5	0			
	123	5	0			
Deduct 40*s.* per head for improvement	16	0	0			
				107	5	0
4 Horses, 11 months, at 23*l.* 9*s.* each per ann.	85	19	8			
Add 40*s.* per head for decline of value	8	0	0			
				93	19	8
Balance in favour of the horse-team .				13	5	4

or, 14*l.* 9*s.* 1*d.* per annum. This, indeed, supposes the horses to be worked in the same manner, consequently with only the expense of one man and a boy driver, instead of a head ploughman and his mate; and it does not allow for the difference in wear between ox-yokes and horse-harness, which charges, if calculated, would bring the expense of the teams nearer upon a level.

Were the hay and the soiling to be valued at a less sum, the tenour of the calculation would not be thereby altered, for the valuation of the horse-provender should be also in that case proportionally reduced; and, in fact, an ox consumes at the rate of about one-fourth more food than a horse of proportionate size and constitution *. The soiling of each would therefore cost more than that of a horse; and, although Mr. Billingsley's oxen were only grazed, which appears the cheaper mode on the face of his account, yet it is not so in reality, when the saving of waste and the value of the dung are duly estimated. Now, there can be no doubt that four horses, either worked in one team with a double-furrow plough, or in pairs with single ploughs, would have performed the same labour; but admitting—according to other statements—that eight oxen, of the best working breeds, can do the work of five horses, still the cost of maintaining them throughout the year, in the manner already stated, wages being the same in both instances, would amount to nearly as much; for being, in that case, employed upon the road, they must be shod—a charge which is not made in Mr. Billingsley's account, as his team was only used at plough. They would also require more hay during the winter; and in summer they should be soiled at least during the day. The comparative expense would therefore be—

* This has been ascertained, as nearly as difference of constitution will permit, in many instances: in one, mentioned in the Northumberland Report, three working horses, about 15½ hands high, consumed at the rate of 16 st. of hay and 12 gallons of oats each per week; and four Durham oxen ate, in the same time, each 19½ st. of hay and 10½ gallons of oats. In another, an ox, 3½ years old, and a horse of 15½ hands, both idle and put upon hay, also severally consumed at the rate of 33lbs. and 28lbs. per day; but it is worthy of remark, that, when the Durham oxen were fed on hay alone (without oats), their weekly consumption only increased to 20 st.—3d edit., p. 135.

	£.	s.	d.	£.	s.	d.
5 Horses, 1 year, at 23*l.* 9*s.* each	117	5	0			
Add for decline of value 40*s.*	10	0	0			
				127	5	0
8 Oxen, 24 weeks' pasturage and soiling at 5*l.* 5*s.* each	42	0	0			
28 do. on hay, 1 ton per week, at 65*s.* per ton	91	0	0			
Shoeing and farriery, at 20*s.* each	8	0	0			
	141	0	0			
Deduct for improvement 40*s.* each	16	0	0			
				125	0	0
Difference in favour of the oxen				2	5	0

To which, however, there should be added interest upon the superior value of the horses, and the difference between the expense of their harness and the gear of oxen, provided the latter be worked in yokes. Perhaps, however, taking into account the unavoidable pilfering of horse-carters,—which, although it cannot be summed up, will yet be found to amount to something, in spite of the most prudent management,—an aged ox may, on an average of years, be kept, as calculated by Marshall, at two-thirds of the expense of a large cart-horse*.

From these estimates it appears that there can be but little economy in keeping working oxen on hay, putting corn entirely out of question. The allowance, indeed, which amounts to 40lbs. per day, with an unlimited use of straw, may seem large; but the Sussex and Pembroke cattle, already mentioned, consumed at the rate of 36lbs. each of clover—some will eat considerably more; and, in fact, no definite quantity can be assumed, except as an average for the purpose of calculation, for even animals of similar breed, age, condition, and work, have not all appetites alike, and those which labour necessarily consume more than those which are idle†. The expense, however, may be considerably reduced on farms where green crops are regularly grown, by feeding on straw and roots during the winter, with the allowance of a moderate quantity of hay in the spring, and thus, including every charge, the cost of a double team, consisting of four, might amount to—

	£.	s.	d.
4 Oxen, soiling and pasturing, at 5*l.* 5*s.* each	21	0	0
2 acres of turnips, and drawing, at 6*l.* per acre	12	0	0
Hay from Candlemas to May, at 1 cwt. or 2 trusses each per week; say 3 loads of clover at 3*l.* 3*s.* per load	9	9	0
Straw, say 1¼ ton each, at 20*s.* per ton	6	0	0
Interest on first cost (60*l.*) at 5 per cent.	3	0	0
Shoeing, farriery, repair of yokes and chains, &c., at 25*s.* each	5	0	0
Risk of accident—calculated at 1 in 60—5*s.* each	1	0	0
	57	9	0
Deduct for improvement 40*s.* each	8	0	0
	49	9	0

Or, according to a calculation in the West Lothian Report, made from many years' actual experience on a very extensive farm in one of the best

* Minutes of Agriculture, p. 46.

† One ox has used 30 cwt. in eight weeks (Annals of Agriculture, vol. xvi. p. 5), and many similar instances might be quoted of equal consumption, though perhaps a portion of it may be waste. Two Devon and two Hereford oxen, in regular work, supplied with a clear 100lbs. each pair per day, and what remained uneaten taken back,

cultivated districts of Scotland, on which several teams of both horses and oxen have been constantly employed, and where three oxen have been found equal to a pair of horses at every species of labour except road-work—

	£.	s.	d.
3 Oxen, 8 months on straw, at 30s. each	4	10	0
3 acres of turnips, at 6l. 10s. per acre	19	10	
4½ acres of good pasture, at 3l. 3s.	14	3	6
1 acre of cut grass or tares	6	0	0
Hay in the middle of the day in winter, 60 stone of 22lbs. (11¾ cwt.), at 1s. per stone	3	0	0
Shoeing	1	1	0
Annual risk of accident, calculated at 1 in 80	11	3	0
Do. loss by being kept until seven, instead of being sold off at three years old—25s. each	3	15	0*
	52	10	9
Deduct for annual improvement	5	15	9
	46	15	0

Thus, supposing a team of two horses to work out four of oxen, the difference between them, according to our previous calculations, would stand thus—

	£.	s.	d.	£.	s.	d.
2 Horses cost 30l. each	60	0	0			
12 years' work—support, at 23l. 9s. each	562	16	0			
	622	16	0			
Sold for	10	0	0			
				612	16	0
4 Oxen, cost 15l. each	60	0	0			
3 years' work—support at 57l. 9s.	172	7	0			
	232	7	0			
Sold for 21l. each	84	0	0			
	148	7	0			
Cost of four teams				593	8	0
Saving				19	8	0

Or, according to the West Lothian statement,—

	£.	s.	d.	£.	s.	d.
2 Horses, during 12 years				612	16	0
3 Oxen, 3 years, at 52l. 10s. 9d.	157	12	3			
Bought for 15l. each	45	0	0			
	202	12	3			
Sold for 21l. each	63	0	0			
	139	12	3			
Cost of four teams				558	9	0
Saving				54	7	0

The calculation of a farmer in Anglesey, who says that he worked twelve horses and twenty oxen during three years, and performed an equal quan-

consumed in six working days 939lbs.—thus: the Devons 489lbs., or 40¾lbs. each per day, and the Herefords 450lbs., or 37½lbs. each per day.—Survey of Bedfordshire, p. 536. See also the note on clover, at p. 136 of this work.

* This charge is made on the supposition that oxen, when four years old, are worth 25l. each, or 75l. the team, and the interest is calculated on that sum, instead of 45l., which may be assumed as their actual cost at three years of age.—Trotter's Survey of West Lothian, p. 298.

tity of work with that number of teams, states the difference in favour of the oxen, during that time, at £236*l*.*; and the Surveyor of the county of Sussex estimates the difference of expense between the keep of four horses and eight oxen, during the year, at 41*l*. 12*s*. in favour of the latter. This, however, is contradicted by another account in the same report, by which the balance in favour of the horse-team is made to amount to 44*l*. 0*s*. 6*d*., but then it is assumed that three horses perform the labour of eight oxen†.

Different opinions will no doubt be entertained regarding these estimates, and it is clear that they must vary in amount according to many circumstances to which no general rule can apply; but, at whatever sum the saving may be calculated on the employment of oxen, there must be placed against it the superior handiness and more general usefulness of horses, their more active execution of work, and greater despatch of business. That oxen are generally slower cannot be denied, notwithstanding the instances which have been adduced to the contrary; and expedition is often of more importance than any other consideration. In ploughing for turnips, for instance, and getting the manure and seed into the ground, too much haste cannot be used: the sowing of Lent corn is sometimes so critical, that a few days may make a considerable difference in the crop; and more may be lost by delay in getting the harvest out of the field in catching weather than would be repaid by any saving that can be made by them. The expediency of their employment must therefore be decided by considerations of convenience, which, although they enter largely into the estimate of individuals, cannot be calculated in figures.

The advantages of oxen depend chiefly upon local circumstances: they are not adapted for clay-land, which produces only hay and straw for their support, unless it contains a large portion of coarse pasture, both because of the expensiveness of hay, and that oxen are more healthfully maintained on roots; but they are well suited to the kind of labour required of them. They are not, from the construction of their hooves, so fit as horses for long journeys on hard roads; but on very wet, poachy ground, where horses fret and plunge when they sink, they work steadily. It is true that the wetness of the soil is an objection to their employment which no one can doubt, for it is often necessary for plough-cattle to walk in the furrow, in order to avoid poaching the land; but the question is merely comparative. They are, for the same reason, better adapted for breaking up old tenacious sward, and for dragging heavy timber out of woods; it is said, that they have been found preferable in the thrashing-machine; and they are superior to horses at a dead pull. That they cannot compete with them for general purposes, and that their inaptitude for some kinds of labour must ever render them imperfect substitutes, to the entire exclusion of horses, is manifest: in fact, were they capable of the same work, they would be invaluable, and farmers would not be the last to discover their worth; but they may be very profitably employed as auxiliary plough-teams on farms which possess a considerable extent of rough pasture, or where, under the alternate system of husbandry, they can not only be maintained with economy, but assist also in consuming crops which might not perhaps be otherwise easily disposed of. The proportion must depend upon the nature of the soil and the course of cultivation; but horses enough should be kept to meet any pressing emergency. The slowness of their pace, too, especially adapts them to the double-coulter plough, in which they may be advanta-

* North Wales Report, p. 383.

† Surveys of Sussex, p. 378, with note in p. 380; and Dickson's Survey of Lancashire, p. 583.

geously employed on land that is not wet, and that works freely. On this subject it is indeed the opinion of a very experienced farmer, 'that, on all light sandy soils, single ploughs of different constructions, drawn by two horses without a driver, may in cheapness of execution nearly approach the double-furrow drawn by four oxen; but on all level soils, unincumbered with stones, and where good pasture may be found for the summer, and good hay for the winter, keeping oxen with the double plough may be considered as justly entitled to the preference *.' They suffer more from heat in the summer than horses, but they are less affected by the cold —particularly wet—in winter; they require less care, and, though their slowness may be considered objectionable, it has one advantage—'that they cannot be hurried like horses, and the land half ploughed †.'

Neither is the comparison between working oxen and horses often fairly tried. A feeble team of horses is inferior to a strong team of oxen; but were both chosen with equal judgment, and equally well kept, the difference perhaps would not be so apparent: the defects, however, generally lie upon the opposite side. Farmers seldom think of anything but bone and strength in the former, but when they are about to purchase horses they put them carefully through their paces, and examine minutely into every qualification, and then a comparison is drawn between them and a pair of ill-fed sluggish oxen. Nor is it uncommon to see working oxen turned into the straw-yard when the autumn ploughing is over, and getting nothing but a spare allowance from the refuse of the fatting-stock, the consequence of which neglect is, that they fall off in strength, and when the spring seed-time arrives, they are no longer equal to their labour; and, if afterwards intended for the shambles, more money will be lost by the extra expense of fatting them than if they had been kept throughout in good store order.

LABOUR

The proportion of draught oxen to arable land varies in almost every district, both from the number of horses employed, and the difference of the soil and nature of the tillage; but from the estimates collected from numberless instances, it may be assumed that a common proportion for 100 acres of average ploughed land may be an ox and a horse team; and for 150 to 200 acres, from twelve to sixteen oxen, if used alone. Though the idea of the superior utility of horse over ox teams is very great throughout most districts, yet the number of working cattle kept in different parts of the country, without any corresponding difference of soil, varies materially. A farm of 100 to 150 acres of land, under the mixed system of husbandry, will be frequently managed by four horses, while small farms, with from 50 to 60 acres, have seldom fewer than three when much of their land is under the plough. It is therefore evident that there is no exact proportion observed; but it is commonly found that the largest farms are worked with the least strength of teams, which, as they are at least equally well tilled, can only be ascribed to a more judicious division of labour, or in some instances, perhaps, to the superior nature of the cattle, or of their keep.

When only one team of oxen is kept, it should always consist of double the number employed together, for they cannot go through a whole day's work every day in the week, and their driver would either stand still or loiter away half his time, if employed on irregular jobs, unless there be a second

* Mr. Billingsley, in the papers of the Bath and West of England Society, vol. x. art. vi. See also vol. v. art. xlviii.

† Hertford Report, p. 200, note.

set to supply the place of those which are resting. They are commonly worked on alternate days, half their number at a time—thus affording three clear days' rest; and in winter, when there is little doing, and the days are so short that there is but one yoking, that is perhaps the best plan; but in spring and summer it has been found better to work them every day—one half in the morning, and the other in the afternoon,—for they require more time to chew the cud than is allowed by the usual interval between the yokings. All ruminating animals are possessed of strong muscular fibres in the gullet, which render the process of rumination so perfectly voluntary that it is not confined to any particular time, and can be delayed until the paunch be quite full, or continued at pleasure; they may, therefore, apply a portion of the food to their refreshment while at work, but the operation is effected with more comfort when left to their repose: they otherwise become jaded, and if thoroughly tired, even an entire day's rest will not always sufficiently recruit them. This of itself forms a strong objection to the employment of three as a team, in which case two are worked at a time, and only one rested on the following day; for, although it allows of two clear days' rest in each week, it yet also occasions two consecutive days' labour; and, besides that, a jaded ox being thus yoked with one that has been refreshed, they step unequally, and the work, being necessarily regulated by the strength of the weaker, is imperfectly performed. The latter part of the objection would, however, be obviated if *three sets*—of six, or of twelve when four are worked together—were employed to do the work of *two ploughs*; because then one complete set might be rested at a time, and, when the labour is not excessive, that number, if well kept, may in many cases answer every useful purpose.

Another objection has been urged against the use of oxen as compared with horses, arising from the inconvenience of frequently changing the team; for they are generally fatted off after three or four years' work. If, however, the mere consideration of convenience be allowed any weight in opposition to pecuniary profit, oxen may be worked with even more advantage, *as to mere labour*, until they are ten or twelve years old, than only, according to the usual custom, until they are seven; for an ox is not, any more than a horse, in his prime for the yoke or collar until his sixth year. But then, they will not increase in value in an equal degree *as beef*, for they arrive at their greatest weight at seven years of age, and the union of both growth and fat in the young beast pays better than fat alone. Thus, supposing one team, of four, to be worked eight years consecutively —from three to eleven years old,—the presumed annual gain of 40*s*. upon their growth ceasing after their seventh year, the profit upon their improvement in weight would be only 32*l*.; whereas, were they sold at that age—that is, after four years' work—and replaced by another young team, to be employed during the remaining four years, and then sold, that profit would be doubled. Aged bullocks, besides, do not in general fatten so kindly as the younger beasts, though there are many instances to the contrary *; nor is their flesh either laid on so evenly, or so much esteemed by the butcher, as that of younger cattle: they would consequently be worth less at eleven than they would have been at seven years of age. At the shambles, indeed, four years old cattle are generally preferred, as the meat

* Among others, two are mentioned in the Sussex Report, of working oxen, eleven and twelve years old, on the farms of the Earl of Egremont and Lord Sheffield, being fatted to great weights in as short a time as young beasts:—p. 234, and the Appendix, p. 466. See also the Herts. Report, chap. xiii. sect. iv. p. 204; and the Library of Useful Knowledge, Farmer's Series, on Cattle, No. 11, p. 42.

is considered more juicy at that age than later, when it is thought to become coarse and muscular, or *corky*, on the working points, though there can be no doubt that it possesses more savour and substance when the beast has reached maturity; and it may be observed that young, or half-grown flesh, does not take the salt so well, when intended for ship-beef, as older meat.

It has also been much insisted on, as an argument in favour of horses, that, were they sold at the same age as oxen, there would not only be no loss by decline of value, but, on the contrary, in most cases, some gain by improvement. That mode is indeed pursued as a business by some farmers in the breeding counties, with considerable success *; but as a general plan it would be wholly impracticable; for, were it adopted by all, it is obvious that there would no longer be purchasers enough to buy them. The broad question of comparative advantage—independent of particular instances—can only be decided upon principles that are generally applicable: it is inseparable from the nature of the horse that his first cost must be ultimately irrecoverable, and it is inevitable that the chief weight of that loss should be borne by the farmer: it is peculiar to the ox that his purchase-money is recoverable, with profit: therefore, in estimating their comparative services, in any general view, that difference must be taken into account.

NATIONAL VALUE.

The ground on which the general use of oxen has been chiefly advocated by writers is that of national advantage, which governs no one. It may serve the theory of a political economist, or it may influence some patriotic nobleman, to whom the balance of his steward's account of 'the home-farm' is matter of indifference †; but it has no effect on the mere farmer—nor should it; for, as his profit can be derived from no other source than his marketable produce, his interest chimes with that of the public, and whatever is most beneficial to himself must be equally so to the community. The real point at issue therefore is—Which team is the most profitable to the farmer? That we have already endeavoured to explain: but, as matter of general interest, it may be worth while to examine the argument in favour of oxen, especially as it was urged in parliament as a motive for the tax on agricultural horses.

The presumed advantage to the public of oxen over horses, as working cattle, is supposed to consist both in their not consuming corn, which is thus left for the support of man, and in their adding to his means of subsistence when they are brought to the shambles; and were they equal to horses in point of labour, there could be no doubt upon the subject. The contrary, however, being the fact, the question of national expediency can only be decided by a calculation of the amount of food brought to market from the same quantity of land tilled either by oxen, or by horses.

In a 'Comparative Statement between Horses and Oxen for the purposes of Draught,' drawn up by Messrs. Bailey and George Culley, in the Northumberland Report, and which, from their deservedly high character, has been universally quoted, and relied upon by all the advocates of horse teams as decisive of the question, it is assumed that *two horses are equal to six oxen in regular work, and to eight during the first year*, supposing

* See the Surveys of Durham, p. 259, and the North Riding of Yorkshire, p. 278; and Communications to the Board of Agriculture, vol. v. p. 364.

† The Earl of Egremont, whose exertions in the cause of agriculture cannot be too much praised—though in this instance perhaps misdirected—is said to allow a reduction of 3 per cent. on their rents to such of his tenants as use oxen only in the cultivation of their farms.

them to be yoked at three years old; and thus the expense of an ox-team, including the charge of a driver, is made to amount to double that of the horses. On the justness of that calculation it is unnecessary, after all we have already said, to make any remark; but as these gentlemen take a more enlarged view of the subject, and it is one of no small importance, it may be proper to quote their own words regarding the impolicy, on both public and private grounds, of working oxen under any circumstances; they are as follows:—

'It is a fact known to graziers of short-horned cattle, that an ox at three years old, put to fatten for six months, is worth more to the butcher at three and a half years old, and will bring more beef to market, than the same ox worked at three years, and then fattened six months, would do at six and a half years old: hence, if the land employed in supporting this working ox three and a half years, were applied to rearing and feeding another ox, it is plain that a considerably greater produce in beef, tallow, and leather, would be brought to market by pursuing the system of *breeding oxen for fattening only, instead of working*, and using horses for the purposes of cultivation, as the oxen would in that case be all brought to market at three and a half instead of six and a half years old.' They then assume the difference between the food of the horse and ox teams to be 13 acres against the latter; and, calculating the produce of that quantity—one-half of which is supposed to be in pasture—at 8 cwt. of beef, 10 qrs. of oats, and 5 qrs. of wheat, and supposing the tillage land in Northumberland to require five thousand teams, they show that the annual loss in that county alone would amount to—

5000 ×	8 cwts. of beef	=	40,000 cwt	
5000 ×	10 qrs. of oats	=	50,000 qrs.	
5000 ×	5 „ wheat	=	25,000 „	*

Nothing is more easy than to draw inferences in favour of any theory if a man be allowed to assume the facts upon which he founds them, and here we find—that not only are young oxen placed in competition with full-grown horses, but that six are assumed as requisite for the work of a pair, though all the practical evidence, on both sides of the question, shows that four are amply sufficient. The following will probably, therefore, be found a more correct statement, viewing it only in round numbers, as complete accuracy is neither possible, nor necessary to the subject.

A working horse is commonly supposed to consume the produce of 4 acres of ordinarily good land annually, and we have seen that an ox eats one-fourth more in weight, which, were they fed upon the same food, would bring his consumption to five acres; but, as he can be partly fed upon straw, which would be used as litter were he not to be supported, and consequently ought not to be estimated in a national account, he may be well maintained upon 2½ acres a year of the above quality, while in work, and 1½ may be required to fatten him afterwards for market. Horses, it may be presumed, will require the produce of 6 acres to bring them to the age when they are broken to harness: but, in the manner in which steers are usually fed, they can be reared to their working age with 5 acres. Now, farm-horses will, upon an average, work at the least twelve years, and in that time will wear out four teams of oxen used only three years each; and supposing one horse to be equal to two oxen, the quantity of land which each will require will be,—

* Survey of Northumberland, 3d edit. chap. xiii. sect. iii. See also the General Report of Scotland, vol. iii. chap. xiv. part iii. sect. ii.

1 Horse, until fit for work	6 acres.	
12 years work, at 4 acres per ann. . .	48	
	—	54 acres.
2 Oxen, until fit for work, at 5 acres each .	10	
3 years work, at 2½ acres per ann. each .	15	
Fatting, 1½ acre each	3	
	—	
This four times in 12 years . . .	28 =	112 acres.

The difference would therefore be 58 acres: but there would have been *eight fat oxen* brought to market. It therefore remains to be seen, whether these 58 acres would produce more beef if applied solely to the feeding of young stock for the shambles; and, as they would be fatted on less food than cattle that have been worked, they may be in general supposed to consume only 6 acres, which would bring their number *under ten*. It must, however, be remembered that a bullock will weigh heavier at seven than at four years of age—to the extent probably of 15 to 20 stone of meat and tallow, of the common working breeds—and the average market account of a pair of fair Herefords, of those ages,—when grazed, but without calculating the effects of stall-feeding—may stand thus;—

	Stone of 8 lbs	Stone of 8 lbs.
1 ox, 3 to 4 years old .	beef, 110 to 115 .	fat and hide, 20 to 25
1 do., 7 years old . .	„ 120 to 130 .	„ 25 to 30

The difference in product is thus not material, and the estimates, though of course open to some cavil, will probably not be found far from the truth. Nationally, therefore, no advantage would be derived from the exclusive use of oxen in the plough; and their general employment would injure the breed of heavy cavalry and light draught horses, great numbers of which are grown out of farmers' mares. But the calculation in the statement already alluded to cannot be supported to the extent in which it has been made; and there can be no doubt that, in certain situations, and under certain circumstances, the use of oxen as working cattle may be found individually profitable *.

HARNESS.

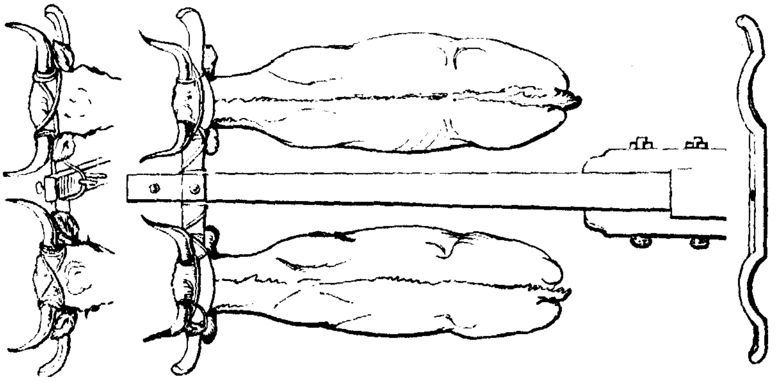
The best manner of harnessing oxen has been made a subject of almost as much dispute as the propriety of working them, and opinions are as much divided respecting the merits of yokes, or of collars, as regarding oxen and horses. The most ancient, and until within about the last century the only mode, was the yoke, which nature seems to have pointed out in the strength with which the animal is furnished about the head: he uses it for defence, and when extraordinary exertion is required at labour, he, when yoked, puts his nose as close as possible to the ground, thus evidently pulling by the muscles of the neck. Throughout the south of Europe, where oxen are generally used for labour, it is the sole method known of attaching them to the plough or cart; but they are there universally worked in pairs, whereas in this country they are sometimes used singly in carts, or one before the other in the plough, in which cases the yoke is certainly awkward. Its cumbersomeness, when they are yoked singly, suggested the idea of horse collars and harness, which being found to answer the purpose for light work, has been also very extensively adopted as an improvement on harnessing pairs, although that, as we shall presently see, is of very doubtful value.

* Perhaps in no mode could agricultural societies apply the means which they possess more beneficially to the public than in making and publishing accurate experiments as to the comparative expense of horse and ox labour under varying circumstances.

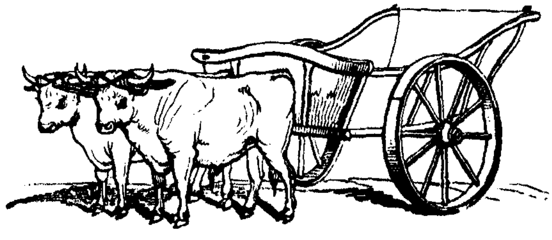
The *yoking of oxen* is effected by means of a wooden bar placed across their necks, at the base of their horns, to which it is fastened in different ways. Under this, but closely pinned to it by the extreme end, runs the pole of the cart, and the animals being thus secured to it by the head, require no traces, nor any other kind of harness, for it is not even usual to furnish them with bridles, and they are guided by the goad, which is merely a long stick pointed with iron at one end. Nothing, therefore, can be more simple and unexpensive; but although the principle be nearly the same, there are different modes of affixing the apparatus.

In this country, the construction of the yoke is indeed very little attended to, and almost any shapeless piece of wood, with holes for the insertion of the bows, is made to answer the purpose; yet the size and fitting of the bow to the neck of the bullock, and the position of the staple and ring in the yoke and pole, are altogether material to the ease of the draught. Cattle of the largest size require a yoke of from 4½ to 5 feet in length; if shorter, they are apt to acquire a habit of drawing from each other, and thus, in some instances, cross their fore legs in a manner which greatly lessens their power and impedes their progress.

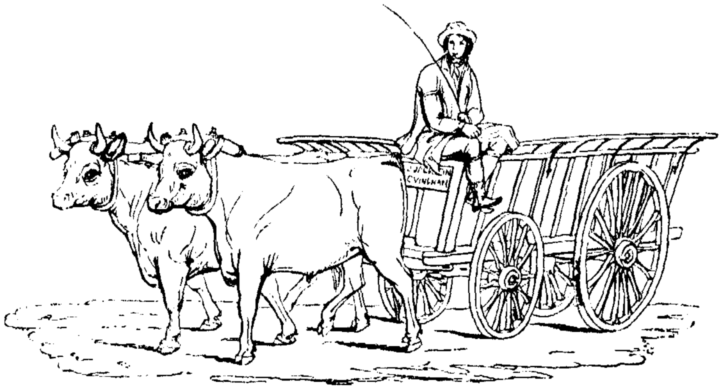
In France, the bow is not used, but the fastening of the yoke is effected by a long leathern strap, which is first wrapped round the outer side of the yoke, and then round the base of the outer horn, from which it passes across the forehead to the other horn, round which it is also twisted; then crossing the horn of the off ox, it is finally secured to the bar of the yoke, which is fastened to the pole by an iron pin, thus—



The yoke thus presents a view of the instrument; and the principle of draught consists in the power of the head and neck, which allows of complete controul over the animals' heads, and renders them perfectly tractable while drawing, in the following manner—



In England the custom is to attach the yoke round the neck by a hoop of alder, or of elm, fixed under it, which, passing through the yoke, is then fastened to the upper part with buttons, or pegs, upon the ends of the hoop, which is called a bow. The yoke—which somewhat resembles that already depicted as used in France, though in a rather ruder fashion—being thus put upon the oxen, is either pinned, or chained, to the pole, in the following fashion, without any other fastening whatever, and is the ancient mode adopted by the Romans, who preferred the collar round the neck to the fastening by the horns.



When ploughing, however, the pole is of course useless, and the yoke is then fastened by a chain passing from the ring in the yoke to the draught-iron of the plough. This, if made light, and well fitted to the oxen, is considered preferable to collars, traces, and splinter-bars, which are complex and expensive; and a pair in yoke is certainly the simplest, and, if the cattle are strong, and step well, perhaps also the cheapest plough-team that is known*.

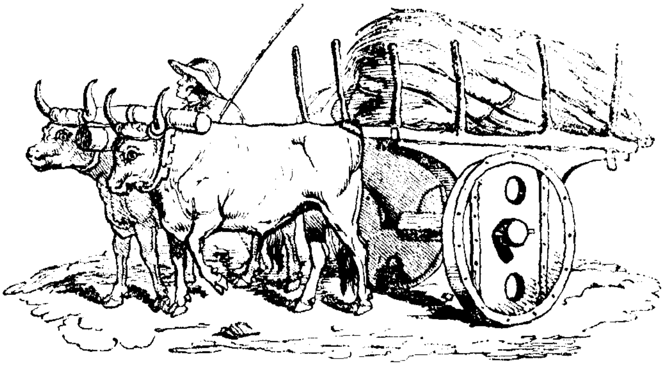
Waggons are unknown throughout the peninsula; and in presenting an accurate view, by the late Lord Somerville, of the coarse and unwieldy tumbrel in general use throughout Portugal for every species of farm-labour†, it will be hardly supposed that we intend to recommend it to imitation. But it has been thought that no better proof could be afforded of the power of oxen, as beasts of labour, than a representation of this clumsy machine; coupled with the fact that, notwithstanding its inconvenience, a pair will draw a tun of wine, or even 25 cwt., with great apparent ease, not only through the steep and badly-paved streets of Lisbon, but on

* Marshall, in his Rural Economy of the West of England, notices a material improvement in the construction of the yoke. That part which rests upon the withers of the ox is broad and gently convex on the under side, by which it fits easy and is light; and to prevent this thin part from being split by the action of the bows, the rivets are run through it horizontally, close to the outer sides of the bow. This may also be remarked in some other counties, but here the draught-iron—which, instead of having, as is usual, a single staple, or eye, to receive the ring, the crown of the staple is enlarged, and is divided into three compartments, or notches, like those of the draught-iron of the plough, in order to give the weaker ox the requisite advantage. The staple also is inserted, not perpendicularly, but diagonally, entering the lower angle of the hind part of the yoke, and hooting upward and forward to the opposite angle, where it is keyed in the usual manner.—Vol. i. p. 125; vol. ii. p. 143.

† Facts and Observations, &c.; and Illustrations of the Board of Agriculture, by John Lord Somerville, 4to, pp. 161, 163.

cross-country and mountainous roads, over which no English carter would venture. The circumference of the axletree is from 19 to 22 inches, according as they are more or less worn; the body supported by two stays of 5 inches wide on each side, which clip the axletree in a semi-circular fashion, about half of its circumference, which is composed of solid and ungreased timber. The weight of such a load, with such a friction, is so infinitely greater than upon our principle of wheels, as to render all comparative calculation useless; yet is it a rare thing to see the oxen, which are about the size of the North Devon breed, out of condition, although pasture-land is in that country unknown.

The method of draught, it will however be perceived, adds a flexible bow, or a thong of leather, which encircles the neck, to the strappings of the horn and the yoke, and therefore not alone affords the most effectual draught, but also secures its entire steadiness.



This also affords the further obvious advantage, that it allows of two points of draught, instead of one,—*the joint power of the neck and the horn,*—the latter of which is lost in the English mode; and, thereby relieving each, admits of a lighter yoke, which is in this country far too heavy and oppressive. It would therefore be a very desirable improvement, and, if added to either the French or Portuguese mode, could be practised in England with the greatest ease.

The French method of yoking oxen was introduced into Ireland a good many years ago by the Earl of Shannon, and an improvement on it has been effected by giving to each beast a separate yoke, or forehead-board, under which the animals step more freely than when bound together, and can besides be worked singly, as represented in the annexed cut.

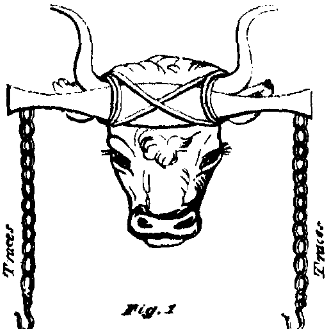


Fig. 1

Fig. 2.

The yoke consists of a flat piece of ash about eight inches wide in the middle, reduced to three at the ends, and proportioned in length to the size of the ox, the object being just to clear his sides from the traces, or chains, as at figure No 1. This board is lined with woollen cloth and stuffed with hair; to an iron staple affixed at either end is hooked a long trace, or chain, which reaches from the extremities of the swingle-tree.

Figure No. 2 represents the back-band, which is of ash, about 14 inches long and 3½ broad, concave within and stuffed with hair so as to lie with ease across the back; at either end hangs a short chain, to which the traces are hooked up.

When four oxen are yoked, the draught is in like manner with long traces, and those of the leaders are supported by a strap across the shoulders of the hinder cattle. It is however desirable, in the choice of oxen under this yoke, that their horns should point upwards so as not to interfere with the trace: in this country the shape of the horn is sometimes *set* by art, but it is a severe and cruel operation.*

It will be observed that the draught from this yoke is solely from the neck, and not at all from the horns, to which the board is only strapped to prevent it from falling off; so that in this manner the ox rather pushes than pulls. The intelligent reporter of the King's County, from whom this description is taken, says, 'that the cattle are very easily broken to this method; that they step out very light and free, and though severely pressed, to prove the experiment, on a broiling summer's day, in a very heavy fallow, and up-hill for a long pull with the coulter buried to the beam, they worked quite easy without puffing or lolling out the tongue, which would have severely distressed the best trained and strongest bullocks if harnessed in the usual way from the shoulder†.' The plan has, in fact, been admitted to be an improvement on the common mode, but such is the force of prejudice, that it has not been adopted by the neighbouring farmers.

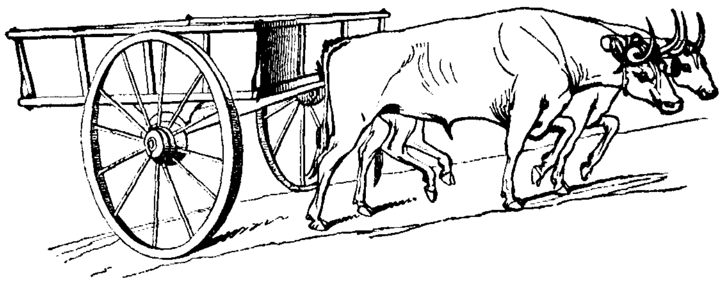
The yoke, in whatever manner affixed, must be admitted to be unsightly and uncouth in appearance to those unaccustomed to it. The advocates of the collar insist, too, on the superior advantages of lightness and quickness of step in single ox-carts; and in really light work, where it may not be so much an object to exert the full power of the animal, it certainly does seem to work with greater ease. But the chief value of oxen consisting in slow and arduous toil, it is not for either quickness of step or superior tractability that they should be prized, when speed, however otherwise desirable, is of less moment than strength; and long experience seems to prove that, when yoked, they are not only capable of more severe labour, but that in hot and wet weather, they are less liable to be chafed than when used in collars: while the difference of the expense of harness is also a serious consideration. It would be fruitless to detail the various comparative trials which have been published on the subject, for they are neither decisive of the question, nor of any material importance. There is, however, a prevalent notion existing in England, that oxen are unfit for draught in hilly countries, which is so directly contrary to the fact, when they are yoked, as to merit notice.

It is well known that a large portion of the Peninsula is of a very mountainous character, and yet we have seen that carts of a rude construction are there drawn with weights far greater than they probably could carry with any presumed degree of facility without the assistance of the yoke.

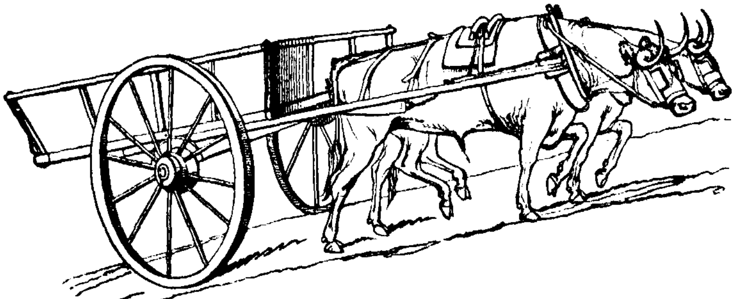
* Survey of Shropshire, p. 265.

† Surveys of the King's County, by Sir Charles Coote, Bart., p. 69; and of Cavan, p. 74.

Throughout South Wales, and in Cornwall and Devon too, which counties are very hilly, oxen are generally used in that manner; for, in this mode of work, they maintain the power of regulating the line of draught, by lowering the head according to the inclination of the road—an advantage which is lost in the application of the collar *. This will be quite apparent by the comparison of a pair of oxen in yokes and another in collars; for the pole, which is of course affixed to the cart, acting upon its body, by being fastened to the yoke, naturally elevates the load when the heads of the cattle are bent towards the ground,—as seen in the first pair—



while the oxen in harness, not having any command, except the mere power of draught, over the other cart, it tilts up in front—as seen in the second pair—and depressing its load from behind, thus increases its weight; and again, oxen, while on the declivities, soon learn to relieve themselves by throwing up the head.



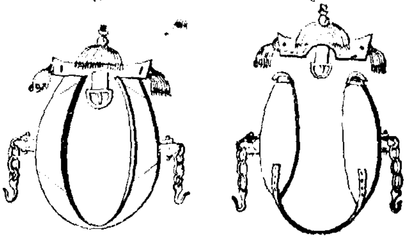
When cattle are drawn by the shafts, or one before the other, it is impossible for the driver to know that they exert an equal force; but when driven by the pole and yoke, the point of draught being in its centre, if the cattle do not use equal power, the yoke will cease to stand square with the pole, and immediately enables the driver to detect the defaulter. The poles to which oxen are yoked are also longer than shafts; and this increase of length, acting as a lever, tends to lighten the weight upon the

* See Parkinson on Live Stock, vol. i. p. 183.

necks of the oxen in a greater degree than a shaft in the common mode of harnessing *.

When worked in collars, they are generally driven two abreast, and often without winkers; and in most places throughout Ireland, instead of collars, a twisted rope is used with straw back-bands, called *suggans* and *gads*, which, though rather offensive to the eye, is nevertheless as safe and easy to the beast as the collar, and much less expensive †. In harness, a horse-collar turned upside down answers the purpose. Wooden collars have been tried for oxen, and two kinds, differently formed, have been used; but there is great difficulty in fitting the shoulders of an ox,—and the hardness of the material employed, when they are not nicely fitted and closely made, hurts the blades. A drawing is added, in case of any one choosing to try them, as there certainly would be a considerable difference in expense; but the old plan will probably be found the most advisable, though those here represented have been recommended by Marshall 'as incomparably preferable to any other ox-collar that he had made use of ‡.' He is, however, of opinion that fig. 1—which is convex, and is, in the fullest parts, from 1 to 3 inches thick, according to the size and shape of the ox's shoulder—deserves the preference, as being firmer than fig. 2,—which is made in the form of ninepins,—as the iron bow by which they are connected is apt to become twisted.

Fig. 1. Fig. 2.



No. 1 appears to bite on the fleshy part of the shoulder, and leaves the bones full room to play. The fault in No. 2 arises, however, merely through some defect in the workmanship. The idea of their construction arose not alone from their being more cheap than stuffed collars, but also from the observation that, when a horse galls, it generally proceeds from some knot or lump in the stuffing; but let the straw collars be ever so hard, yet, if they are quite smooth, they seldom gall; and the truth of that remark is said to have been fully proved on the shoulders of his own oxen, 'for they became as fine and polished as the wood itself.'

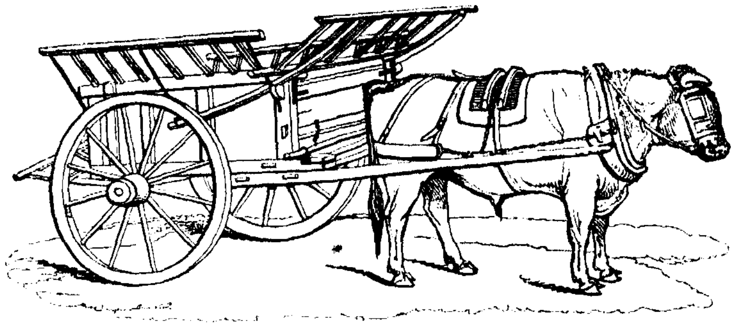
CARTAGE.

We have already described so many carts, that the subject seems almost exhausted; yet oxen have been used in them singly, and in harness, so extensively, that we cannot do otherwise than present a sketch of the figure, which we are persuaded will be found useful in carrying out dung, and other sorts of road-work, provided the distances be not too long, nor the roads too rough or stony.

* Communications to the Board of Agriculture, vol. ii. p. 415. The length of the pole of an ox-cart used at Cowbridge measured 12½ feet.—Survey of South Wales, vol. i p. 210.

† Surveys of the counties of Dublin, p. 305; of Kildare, p. 17; of Clare, p. 56.

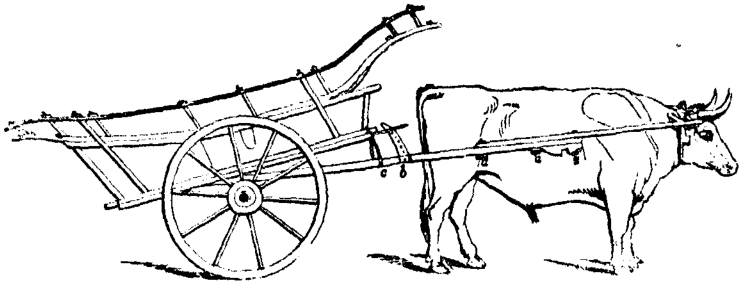
‡ Minutes of Agriculture Digest, p. 55.



The employment of bulls is also recommended in single harness. They retain their vigour to nine or ten years old, and the only objection to their being worked is the fear of their viciousness. They have, however, been found perfectly quiet in harness; and if not, an iron ring put through the nostril, with a strap or cord to it, will presently reduce them to obedience. The operation is very easily performed: the large cartilage which separates their extremities above the nostrils is only divided by two very thin membranes that are easily perforated; it is then opened with a penknife, which is preferable to punching a hole, and there is no necessity for casting them. The ring is about 3 inches in diameter, is made with a joint in the centre, and the parts which meet are flattened inside and screwed together. They are regularly worked in the dales of the moorlands of Yorkshire; and have been thought, in some cases, equal to horses *.

Nor are there wanting advocates also for the employment of cows in the labours of husbandry; neither can we see why they should be left solely to the production of milk, when it is well known that they can be rendered useful by their work. Their product in milk would probably not be so large: but the question is, whether it would not be more in value if added to their work; and also, whether they might not be rendered more serviceable to poor men, who only work them occasionally, or in dairy-farms A cow is in her prime in her seventh year, and is capable of producing young till her twelfth; therefore might be rendered equal to considerable labour, if regularly and moderately used.

There was also a species of cart recommended some years ago by Lord Somerville, which, by a simple contrivance, with a few nuts and screws, at *a a a*, altered the shafts to a length which adapted them either to yokes or to horses, thus—



* Survey of the North Riding of Yorkshire, p. 256; and of Norfolk, p. 482. Annals of Agriculture, v. xlv. p. 73.

It also adjusted the load to the centre of gravity in the declivity of the descent, when going down hill: *b* is part of the neck of a circle affixed to one of the shafts, and having several holes in it, through which a strong pin is placed to keep the body at any required descent; *c* is a small chain attached to the body and th shafts, as a check, in case of its falling.

Many of the carts and waggons already described as used with horses are also indiscriminately employed, with the mere addition of a pole, with oxen. Thus, in the West country, the *Cotswold waggon*, which extends from Gloucestershire to the Land's End, is commonly used for cattle of both kinds: its most striking feature chiefly consists in having an outer rail bending over the hind wheel,—like the *Woodstock*,—the peculiarity of which construction may probably be traced to the *Cornish wain*, which cannot be too much praised for its simplicity and commodiousness in all matters of harvest-work. This lowers the bed of the waggon, without lessening the diameter of the wheels · the body is wide in proportion to its shallowness, and the wheels run 6 inches wider than those of most other waggons: its advantages, therefore, in carrying a top-load are obvious *.

Let those who maintain that oxen are unfit for work in England consider well these plain facts respecting their employment, and their power of labour in foreign countries, which rest upon the established system of a nation. There are, no doubt, reasons, however, which render their use less profitable in many places than that of horses; but in those to which they are suited, and in which they can be rendered serviceable in the less pressing departments of farm-labour, there can be no question that there is a certain degree of economy, and a saving of capital, arising from them, which, to men of moderate means, may often be found essentially useful.

CATTLE SHEDS.

The various modes of sheltering cattle from the weather consist either in open yards surrounded by the farm-offices, or under sheds in which they have the liberty of room and exercise, and in stalls in which they are confined; but as we are not now about to consider the effect of these different modes on the improvement of fatting stock, we shall confine our observations to working cattle.

Were the mere health of the animals to be regarded, there are many reasons which would lead to the conclusion that even in the extremity of the winters of this climate, the open air would be preferable. If they lie tolerably dry in the open air, they will not only support their flesh, but, if well fed, they will acquire a firmness of carcase and a degree of strength that stall-fed cattle never possess; and when the object is work, they should live as nearly as possible in that mode which they would choose if left at perfect liberty. It has been so thought by many men of very great experience; and if coupled with the warmth of a well-littered farm-yard, or secured from the piercing draughts of unusually cold wind by a well-protected fold at least 7 feet high, it perhaps admits of little doubt. All working cattle, if guarded from the wet and from currents of wind, feed with more appetite, digest with more ease, work with more vigour, and encounter accidental exposure with less danger of harm than when confined within walls, inhaling an impure atmosphere, from which, if not prevented by the contrivance of man, they would fly. In the great grazing farms in Ireland, the cattle are allowed to take an extensive range, and vast herds may be observed together, spread over the hills, where scarcely a tree or

* See p. 158 and Marshall's Rural Economy of Gloucester, vol. i. p. 57.

even a bush is to be seen, and it is there believed that they thrive in proportion to this liberty; for, although they draw close to any shelter which they may find near them in bad weather, or towards the approach of evening, yet the herdsmen generally think that open grounds are more favourable to fattening *. But there are other considerations which also enter into the view of most farmers, and which are at least equally entitled to attention. Whatever may be the speculations of naturalists upon the health of cattle, there can be little doubt that working stock require protection from the weather during the winter; and when that can only be afforded by the straw-yard, it should be rendered as complete as circumstances will admit. Thus, the greater degree of comfort that can be procured under warm buildings, even if these consist only of loose sheds, is a point which weighs in the appearance of the cattle, which commonly carry a better coat when so protected, and consequently wear the semblance at least of better health. They are also more tame when tied up than when kept loose. When any disturbance occurs in the yard, a loose bullock will rise and fly from it; while he who knows that he has not the power of flight, lies still and chews his cud: then, in close stalls there is security from accident, greater regularity in feeding, more attention to cleanliness, and a considerable saving from the waste of dung. The latter is indeed an object of so much importance, that it cannot be too strongly impressed upon the attention of every man who is capable of duly estimating the value of manure.

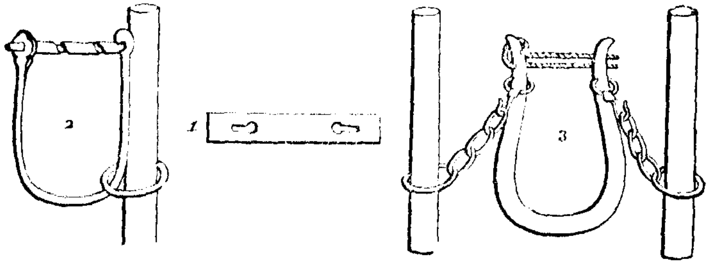
The opinions entertained upon the subject of management are very various, but as we have already premised that our present observations merely apply to working cattle, we shall only again observe, that however much extreme warmth may be recommended by some graziers for the improvement of fatting beasts, working stock should never be deprived of the free circulation of pure air; and viewing that as a preliminary observation on the buildings applied to their use, they should be lofty and roomy, yet not so wide, when stalled, as to allow them to turn round towards the manger, as they would thus dung in improper places and annoy each other. When large beasts are kept in single stalls, perhaps 6 feet would not be found too spacious; but it must be admitted that they are much more frequently placed in double standings, and from 9 to 10 feet, and, in some stalls, even less, is considered sufficient. The standing should extend about 9 feet from the wall, and the manger should be fixed so low as that when the ox lies down his head may be above it; for if placed so high as to force him to draw back, he will be compelled to lie in his dirt, because, when he stands to feed, he drops his dung in the very part to which his hind quarters will then extend. There should also be a groove and channel of about 14 inches wide and 9 inches deep behind the stall, as a receptacle for the dung, in which cattle will seldom stand, as the depth of the groove would place them in an inconvenient position; but thus standing unavoidably upon the edge, the dung will be voided within the channel, which is a point that should be attended to, as cattle that lie in the dirt will never thrive so well as those that are kept out of it †. It should, however, be observed that these channels should never exceed 9 inches at the most, in depth, as serious accidents have happened to cows, when heavy in calf, by slipping into them and straining themselves. At Stowe, the channels communicate with an iron grate under the cattle-shed, and the urine is thence conveyed by a pipe into the common drain of the yard; a practice well worthy the

* Weld's Survey of the County of Roscommon, 1832, p. 374.

† Parkinson on Live Stock, vol. i. chap. i. sect. xix.

consideration of those who are not blind to the advantages to be gained by this economy of manure*. It is a more natural position for the animal to stand, or lie, rather lower before than behind: if the stalls are made with an inclination to the channel at the foot, their quarters should, therefore, always be raised with a small quantity of dry straw; and the partition should neither be so long, nor so low, as for the hocks of the beasts to strike against it when they lie down. The stalls, however, are not commonly littered; it is a more usual practice to allow them to lie upon the bare pavement, though in some cattle-houses boarding is substituted. Straw, however, cannot be dispensed with in an open shed, and a clean and dry bed will not only tend to the comfort and rest of working cattle, but will greatly contribute to the increase and perfection of the manure.

There are various modes of fastening the beasts to their stalls: in some, the posts to which they are tied have iron crows or staples, with a ring to slide up and down as the beast moves his head, with a piece of chain fixed to it about the middle, and a ring at one end with a hook like a T through the other, according to the length of the bullock, so as not to allow it to slip over his horns†. In others, the cattle are fastened to upright posts about 4 inches in diameter, by means of loose iron rings and small bows which are put round their necks. The upper part of the bow is flat, and has two holes in it, as in fig. 1 of the following cut: the bow part is made with split ash, has a button or knob at each end, which is put into the circular holes of the flat head-piece, when, by the spring of the bow, the knobs are prevented from returning by their slipping over the notches, where they become fixed, as in fig. 2 ‡.



There is also a collar, which is slung between two posts,—as designated in fig. 3,—which is much used in many parts of the Continent. In other places a transverse spar is run along the upright posts of the stalls, about the height of the animal's head, bored with two holes between each post. A collar, fixed round the neck or horns, of a proportionate length to allow him to stand at ease, and to lie down, but not to turn round, is then passed through one of the holes in the spar, and continued to the other, where it is secured with a knot and a small knob of wood §. Many farmers, however, use nothing but a halter buckled round the neck, and hooked to a

* Survey of Buckinghamshire, p. 34.

† Ibid.

‡ Vancouver's Survey of Devonshire, p. 473.

§ Berks Report, p. 68.

chain which is mortised into the manger, and thus forms a very secure fastening. Or the common mode of securing their heads between two upright posts, one of which is a fixture, and the other moves in a groove, to allow the entrance of the animal's head; after which the post is replaced and fastened with a pin, which prevents him from drawing it back. The chains, or stakes, should be so contrived, as that no ox should raise his head too high when eating; for in this way accidents sometimes occur by choking: when that happens, however, the feeder should be provided with an elastic ramrod covered with a polished head at the end; which, if introduced into the animal's throat, the obstruction may be very easily pushed down into his stomach: or a drink may be administered of warm salt and water with a mixture of oil.

The sheds and stalls should be kept perfectly quiet, as well as clean, in order to encourage the beasts to lie down. Each manger should possess the convenience of a separate partition for dry food, such as bran, chaff, or oil-cake, without mixture with turnips or other roots. These cribs should also be furnished with troughs, communicating by pipes with a cistern, for the convenience of watering the cattle without the trouble of turning them out, or serving them in pails; and a passage should be left at the head, sufficiently wide for the person who feeds the beasts to supply them with their food without going into the stall. Whether for working or fattening cattle, we should also strongly recommend that every farmer should be furnished with that necessary implement, a *weighing machine*; by which he may accurately ascertain the expense, as well as the work, or the improvement of his stock—or *that breed which possesses the greatest strength, or gives the greatest quantity of flesh, with the smallest quantity of food.*

The plan which we here select, with some slight alteration, from the Farmer's Magazine *,—as designed in the annexed page,—was erected some years ago at Eskmount, in Forfarshire, by Mr. Hunter, for the reception of ten cattle of large size; which, however, considering the width of the stalls, we should alter according to the present measurement, for eight, and is as follows:—

A A are four lattices in the walls, which may be either closed as windows to light the feeder, or left open for the circulation of air.

B B are stone troughs; each beast having one to eat out of. These troughs are slightly arched, so that a bucket of water put into the furthermost one runs through them all to a hole in the wall, and the refuse of their food can be swept out clean.

C C. The passage behind the cattle receives the dung and urine, which also runs out at an opening into a large reservoir at D, from which there are wooden spouts by which the manure may be shifted as occasion may require.

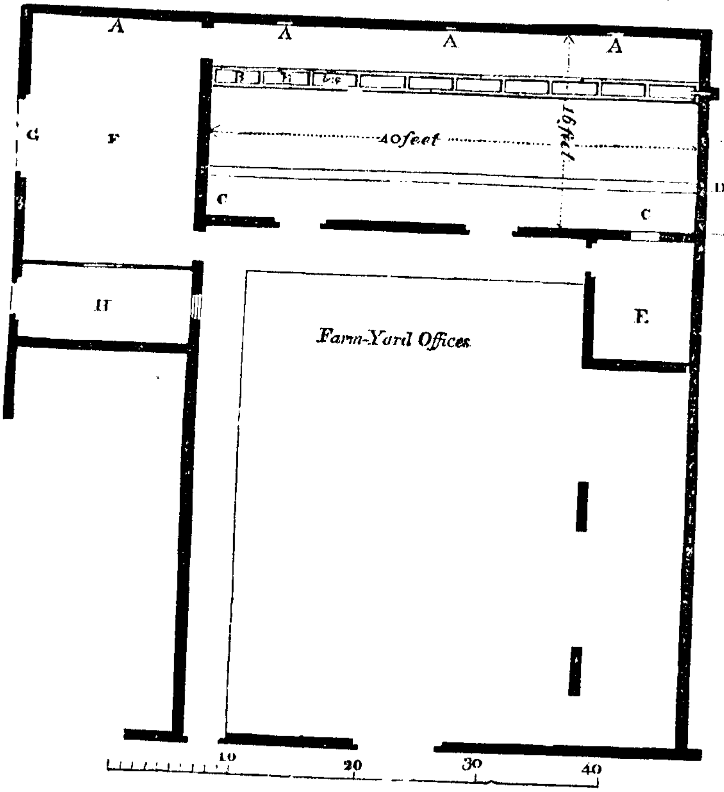
E is a small apartment which may be either used for a ploughman's bed place, or for any other purpose for which it may be wanted.

F is a shed for the storage of turnips or other roots, with a chaff-bin in a corner; and

G is the entrance to that shed, and to the causeway, into which the doors of the beast-house open.

H is a steaming-house for the preparation of the food; communicating with the causeway, and with the root-shed.

* Vol. iii. p. 12.

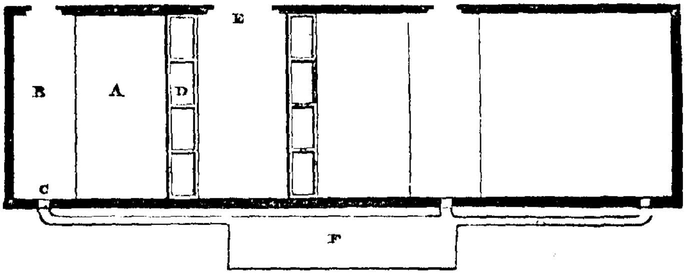


The space allowed for the stalls of the cattle at Eskmount is in the original plan 4 feet, and in other byres 3½ has been deemed sufficient*; but this space will be found to cramp large cattle, for nothing is more prejudicial to them than crowding them close together, nor can anything be more conducive to their health and comfort than allowing them full room not only to stand clear of each other, but also to lie down and stretch themselves when they choose.

The annexed plan is intended for the construction of a byre or cattle-shed, of 60 feet by 18,—but which may be curtailed or extended to any further length,—in which the beasts stand across the house with their hinder parts turned towards each other, leaving a space between them for the laying up of turnips. A are standings, each containing four, or five if the cattle are small, and may be fitted up with cribs according to the former plan. B represents passages, 4 feet wide, behind the cattle, for cleaning out the dung, with entrances to the yard. C is intended for drains, communicating with the urine reservoir at F; D comprises the mangers; and E contains large doors, which may be made on either side, and on that opposite to the rick-yard should contain an opening for the admission of dry fodder. The plan will occupy quite as little room as that for the

* See Marshall's Rural Economy of the West of England, vol. ii. p. 319; and his Midland Economy, vol. i. p. 33.

standing of an equal number of cattle under the former arrangement, and it divides them more conveniently into separate teams on opposite sides of the house, by which food of different sorts and quantities may be supplied to various kinds of stock, each under the care of separate ploughmen.



At Mr. Herbert's demesne, at Mucruss on the lake of Killarney, there is a feeding-house for 50 head of beasts, on such a scale as to afford a separate stall to each bullock, of 9 feet wide, in which he is at liberty to feed or rest without the possibility of interference by his neighbours. In the front of the stalls there is a gangway from whence the fodder is supplied, and in the rear, but not under the roof, a flagged passage of 5 feet wide, with a stream of water confined within proper bounds: to this the bullocks are admitted by opening the gates of their respective stalls, which, on falling back, are hooked to the opposite wall, and still enclosing distinct spaces, prevent any risk or trouble that might arise from the mixture of high fed cattle*.

It is obviously a judicious method of treating stall-fed beasts, that they should be allowed to choose the attitude which they may prefer for repose; but the cost of such a house is a very material objection, and if fitted up in the usual manner it would accommodate double the number. We therefore prefer the plan of Mr. Ruet's sheds, given in the Oxford Report, which will conveniently accommodate twenty head of stalled cattle and twelve loose beasts, within the length of 100 feet, as shown in the following page.

There is a door open opposite to each stalled pair of beasts in the upper yard at A to B. At P are the manger and pump, which, with the feeding-places and water behind, at *t i*, is 4 feet, and 16 feet is the entire width.

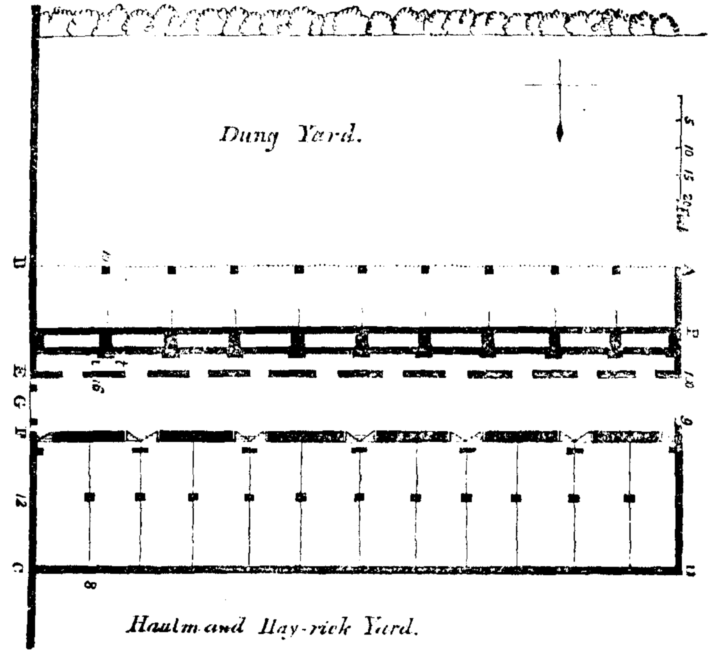
F C D are 12 open stalls, each 12 feet by 8, for the loose cattle; and E to F is a paved passage, 9 feet wide, for the convenience of the attendants. G is the gate to the ox-stalls.

When thus placed, each bullock has his open stall and little yard, the boundary wall of which is about 4 feet high, with an inner range of water-troughs and a channel of communication for the convenience of filling them. The floor is paved with hard-burnt brick, laid edge-way in the mortar, and formed with a descent to the channels, which become drains for the rain-water and urine.

In some instances, double ranges of stalls are constructed on this plan, the area between them being the common receptacle for the dung. When a great number of stalls are thus required, this arrangement brings them within a convenient compass; and the two ranges, with a proper aspect, become shelter to each other. There are also others, built nearly on the

* Survey of the County of Kerry, p. 68.

same plan, but without gates, and on a somewhat smaller scale, in which the cattle are fastened either to the manger, or to partition posts, with a long chain, which gives them liberty to rub and lick themselves, and move about in their stalls; in which case, a water-trough is generally placed at the end of every second partition, level with the manger and with a general pipe of communication to fill them—each trough supplying two bullocks. This plan somewhat lessens the expense, and also prevents the bullocks from fouling their mangers *.



It has been truly remarked by Mr. Webb Hall, in his communications to the Society for the Encouragement of Arts, that the feeding of cattle in stalls is much more easy to accomplish successfully in winter than in summer. In the former period they gladly and quietly accept the shelter afforded to them, while, on the approach of spring, they as anxiously desire the freshness of the open fields as migrating birds seek a change of climate. They will continue in a state of contentment, if not neglected in their food, though tied to the same post during four or five of the winter months; they will generally eat their food with readiness or eagerness, nor do they appear to require exercise or change of place. In summer, however, it is far different, both as regards their food and situation. The food, being at that time in a succulent state, and highly prone to fermentation, becomes very soon heated and distasteful to the cattle, either in the removal from the fields to the stalls, or in lying there till it is consumed: the heat of the stalls themselves, in the warmer season of summer, unless constructed with a particular regard to air, soon taints the food with which the cattle are supplied, and their constant breathing over it requires that their provender should

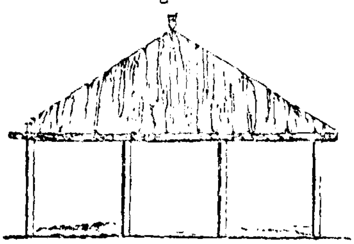
* Marshall's Rural Economy of Gloucestershire, vol. i. p. 254.

be supplied frequently, and only in small quantities. This entails constant attendance and much caution in the supply of their wants; in the absence of which, discontent and a falling off in their condition soon appear, unless very special care be taken to ensure the sweetness and cleanliness of the stalls, either by fresh straw and a frequent removal of the dung and litter, or by such other means as may appear necessary.

On some farms, therefore, the sheds are constructed for loose cattle, with separate yards communicating, in which two are confined alone, and this is considered the preferable method, as the bullocks are thus more secure from interruption by other stock, while, being placed together, they enjoy the comfort of association, which is well known to have a beneficial effect upon all animals. Theory, indeed, could hardly suggest a more rational principle, though it is a point not often considered in their welfare; yet no one who observes them attentively can fail to be convinced that their habits lead to union with each other, and that when it is accompanied by quietude, they thrive better than when alone, and no one who has the care of the creatures which surround him should be wholly insensible to their enjoyments, even if unconnected with motives of self-interest. These sheds are covered; about 12 feet by fifteen, with an open space 12 feet square, divided by a dwarf wall, and containing a cistern or trough for water, with mangers for roots, and bins for hay and straw, as most beasts prefer that mode of picking out their food instead of having it in racks.*

When many are penned together, however, it naturally happens that the oldest and strongest take possession of the crib, and maintain it until their appetite be satisfied, leaving the weakest until the last. This is injurious in more ways than one, for accidents frequently occur; the contention among them always creates waste; and although it may be true that, if sufficient food be allowed for all, the whole may finally satisfy their hunger, yet those which are kept back are fretted, and thrown off the keenness of their appetite, when prevented from regularly feeding. To obviate this inconvenience, there is a very simple and useful open shed, which is thus described in the Survey of Berkshire, where it is now in use.

Fig. 1.



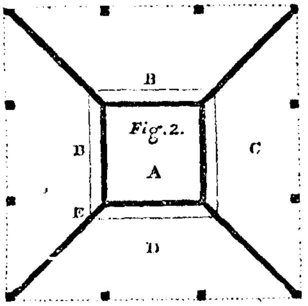


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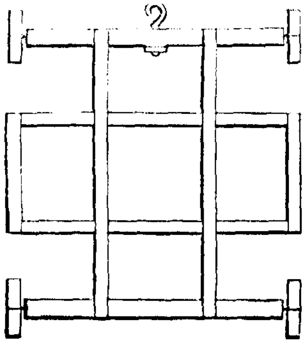
Fig. 1 is the elevation, and fig. 2 the ground plan, which is divided into four compartments. A is a place for fodder of any kind, out of which it may be distributed into the racks and mangers at B. The cattle, therefore, when feeding in C, cannot see those which are in D, or other parts; and if one animal should drive another into a corner—as at E—it is obvious

* See Mr. Waistell's Plans.

that, as none of the corners lie at right angles, the beast so driven can escape with ease; likewise that, from whatever quarter the wind blows, there will always be a part of the shed sheltered from its influence.

A somewhat similar shed was also erected at Dishley, for the use of colts, of which a great number were formerly kept by Bakewell; but it is of course applicable to the service of any other large stock. It consists of a cratch in the centre for hay, and four mangers projecting from it for corn or roots; the whole roofed with boards, and mounted on four wheels, by means of which it may be moved about from field to field, a bolster being affixed to the fore-axle to enable it to turn.



The provender is thus all kept dry; the master-colt cannot easily drive away another without losing his feed, as the one so driven can immediately drop in at a vacant place; and, as they are obliged to stand somewhat distant, they cannot readily kick each other *.

It sometimes, however, happens that a farmer is unprovided with any shelter for his working ox-stock; but slight sheds might be run up against the backs of other buildings adjoining the homestall, and enclosed with a stack-wall of long straw and stubble; or a temporary covering might be erected with a few upright posts, three sides of which may be either roughly planked, or filled in with furze, which will prevent the passage of the wind, and a stack of pea or bean haulm, for winter use, may be piled upon the rafters, and supported by hurdles laid underneath as a roof. A snug shed may be thus raised by the labourers of the farm at the cost of a mere trifle. If the cattle are intended to be tied up, they may be fastened through rings driven into the posts. Cribs will answer the purpose of a manger; and if there be not room at their heads to admit the ploughman when feeding them, a small shutter may be placed outside, between each pair, through which their provender may be thrust. It will not be so convenient as a more regular building, but it will secure a dry and warm shelter, together with a sufficiency of air.

If, however, the straw-yard be not kept dry by drains, as well as by spouts to carry off the rain-water, all the straw with which the cattle can be furnished will not render them comfortable. Instead of having a dry bed to lie upon, and to keep them warm in the cold nights of winter, the damp arising from wet litter chills their bellies, which, being the most tender part of the frame, not unfrequently occasions gripes. Even during

* Leicester Report, p. 66.

the day, their limbs become benumbed with wading through the mire of an ill-arranged yard; and they are thus rendered so comfortless as to be far more sensible to the cold than if they were left wholly unsheltered in the open fields. Of this they show evident signs in their manner and appearance; and it will be found that the dryness of their shelter will conduce more to their health than even an abundance of food, if supplied without attention to that condition.

FEEDING.

So much has been already said upon the subject of soiling *, that, notwithstanding the great importance which we attach to that subject, we shall here only add a few remarks on the consumption of turnips and straw, which enter more largely into the food for oxen than for horses.

Turnips are chiefly grown upon flock-farms for the support of sheep, but in many parts of the country it is the practice to draw some of the largest for bullocks. The drawing of turnips for the supply of working cattle upon open ground, is however but seldom practised, as it is in many respects more convenient to confine them within the interior of the yard; though, when this mode of feeding is adopted, they are not permitted to be in the same enclosure with the fatting stock, which get the choice of the food, leaving the surplus for followers who come after; and in this manner the ground is often divided into three shifts, the food in the latter being cleared off by lean stock only, or by store-sheep †.

When cattle are either housed, or fed in yards, upon turnips, this is better done by laying in a small stock for their use, whenever the weather is favourable, instead of going every day to the field, when the land is perhaps wet, and is soon poached, and the horses employed in drawing them are strained by the labour. At the proper season, when the turnips are completely grown, and the cattle are taken into the yards, these roots are gathered in quantities from the field, and either piled in stacks placed upon the ground, or else carted to the feeding-house, which is made with a door wide enough to allow the carts to back in and throw them down. The turnips, while fresh and palatable, are then given whole—or else the tops and tap-roots are cut off and given to store-cattle—in bins or small cribs, under the sheds or about the yard, and straw is scattered in the course of the day, both fresh and from the horses' litter; for it is remarkable that oxen will often browse upon the litter in preference to sweet straw, and will toss it about with their horns to pick out even that which may have been wetted by urine.

When turnips, however, are intended for *stall-feeding*, the whole of the green tops, or shaws, and tap-roots, are cut off and given to the lean and working stock, and the bulbs, if not stacked, are piled up in one end of the barn or feeding-house, and dry straw laid over them, which will effectually guard them for a long time from being injured by frost. They are then sliced, either by means of coarse turnip-knives or instruments commonly used for that purpose, or else cut into quarters by small choppers upon a narrow bench or a stool, under which there is a basket for catching the pieces. The ploughman, or feeder, holding the turnip by the root, disengages it by one stroke from the top, which is then thrown aside with the root, and the sliced bulbs are alone given to the fatting cattle, which always have a preference over the young and working stock. The advantages thus arising are—that the green tops, being cut off when fresh,

* See No. 5, chap. vii. p. 136.

† Marshall's Rural Economy of Norfolk, vol. i. p. 287.

are immediately consumed; that a large quantity of the best turnips, if allowed to remain on the field during winter, are very commonly spoiled by the effects of the weather, when, if stacked or housed, they may be secured against the most pinching time of the spring; and though they will shrink in weight, yet Swedes, in particular, not only lose no portion of their nutritive quality, until well advanced in the season, but are improved, by allowing their watery particles to evaporate *; provided, however, that this drying system be not carried too far, for it has been proved that bulbous roots may become exhausted of their nutritive properties when too much exposed to the sharp winds of the spring months †. By having a month's supply ready drawn, a farmer need never be deprived of the use of them by severe frost, which frequently so completely locks them in the ground, as to prevent their being got up; or, should he not find it convenient to lay in so large a quantity at once, he can still take the opportunity of a fine day, as it occurs, to add to his stock in the house.

This, however, applies chiefly to Swedes; for, with whatever care the common turnips may be stored, they will show indications of decay in about three weeks, according to the state of the weather, and after that period they become unpalatable. This has been satisfactorily proved by an experiment on feeding with the same turnips—one parcel taken fresh from the field, and the other from a sound store-heap, the leaves and roots of which had been carefully topped and tailed; for several cows were turned out successively in order to prove them, and, after smelling at both, each began to eat those taken from the ground, and did not taste the other parcel until they were finished ‡. It is also impossible to keep a large quantity of turnips of any kind for more than a short space of time under the same roof with cattle, as they soon become tainted by the effects of the breath and perspiration of the beasts, together with the effluvia arising from their dung, and are no longer eaten with any degree of relish. When turnips are overtaken by frost, it is well known that cattle not only find great difficulty in making an impression with their teeth, but that, when pressed by hunger to swallow them, they afterwards discover symptoms of uneasiness—raising up their backs and drawing in their feet, as if seized with a fit of the cramp. But this may be obviated, if the turnips, whilst frozen, be placed under cold water, and allowed to remain there for three or four hours, after which they will be found, on taking them out, to be perfectly fresh and sound.

The *quantity of turnips* that a working bullock may be supposed to consume daily must necessarily depend upon his size, as well as upon the extent of his labour, and upon his constitution, in which cattle differ so materially, that no calculation can be formed that may not be contradicted by other experiments. The quality of the roots also differs essentially, not only according to the particular species, but to the state of culture, the season, and the soil; thus the Swedish turnip contains in the proportion of about three to two more nutriment than any other kind, and although a difference to that extent is not apparent in the other sorts, yet the common white turnip, though the most generally cultivated, and the most abundant in produce, is known to afford less nourishment than any other. They cannot, however, be exclusively preferred, for they require a considerable difference in soil and culture: the tankard, globe, and common white are

* The practice of drawing them two or three days previous to giving them to cattle is very prevalent in some of the feeding districts.—Sussex Report, p. 240.

† Howden, on Feeding Stock: Essays of the Highland Society, N. S., vol. iii. p. 27

‡ Farmer's Magazine, vol. vi. p. 417.

the earliest species, then the red and green tops; after them the yellow Aberdeen; and lastly the Swedes, which, retaining their sap the longest, are preferable for spring feed. Thus Nature supplies a variety according to the season, and animals are found to delight in a change of food *.

It has been judiciously observed by Mr. Sinclair, that those who have made experiments to prove the comparative degree of nourishment contained in the different species of food, by means of feeding and weighing, have found the results of such experiments quite inconclusive, for—

1st. The quality of some species of food will often vary from 1 to 20 per cent. in the course of the experiment.

2ndly. Different breeds acquire various proportions of flesh from equal quantities of the same food consumed by them. And,

Lastly, Scarcely two individuals of the same breed can be found that will gain equal weights of flesh from equal quantities of the same kind of food. He justly remarks that, although a certain quantity of food will maintain an animal for a certain length of time, without sensibly increasing or diminishing its weight or strength, yet, if the food which it can consume be augmented, its flesh and power will be increased. But we have no means of accurately ascertaining the exact proportion required for those two purposes distinctly, for it depends, not on the quantity and qualities of the food alone: the age of the animal, its breed, and its exposure to heat or cold, are also to be considered; the nutritive powers of the food cannot therefore be absolutely determined by those means, though the comparative merits and value of the different breeds are thereby fully ascertained; for it is manifest that it is not occasioned by the deficiency of nutritive matter in the food, but by the want of power in the animal to profit by it †.

Thus no rule can be drawn for the quantity of food which a bullock may require daily, and still less for the power with which he may be able to sustain his labour; but it may be assumed, as a common average of the usual breeds of working oxen, that, if allowed the run of the straw-yard, with about 12 stone of Swedish turnips, to 18 or 20 of the common sorts, they may be maintained in good order; and there can be no doubt that, if allowed that quantity, with plenty of good straw, they will be in a better condition than if fed with a limited quantity of even the best hay alone. Care must, however, be taken to supply them with a sufficiency of palatable solid food, or they will scour. The dry fibre of hay or straw, if combined with turnips, assists materially in correcting the watery nature of the latter; and it has been stated, in numerous instances, that oxen thus fed will go through their usual winter work without any diminution of flesh or strength ‡. In the course of the winter, however, the straw loses a portion of its sap, and the increased exertion of spring sowing requires at least 10 or 12lbs. daily of meadow or clover hay; but still, with the free use of the straw; and if Swedish turnips be allowed, there can be no occasion for the use of corn, which, when given to working oxen, will ever be found a losing concern.

* See a future chapter on the cultivation of turnips, in which there will be found a table of the proportionate quantities of nutritive matter contained in each species.

† Hortus Gramineus Woburnensis, sect. i.

‡ It has been stated, on the authority of Mr. Walker of Mellendean, who used fifty horses and twenty-eight head of working oxen on his farm, that his bullocks never tasted any other food during the winter, except turnips and straw, with perhaps a handful of hay while the ploughmen were eating their dinner under the hedge; that they never were spared a day's usual work; and that he had ascertained that, thus fed, he considered one ox as equal to the work of two on hay alone.—Sir John Sinclair, Scottish Husbandry, 2nd edit., vol. i. pp. 120, 132, 398.

rank it among the first in the United Kingdom. Somersetshire also possessed a heavy breed, much resembling the Sussex ox, probably a cross with the North Devon, now wearing out; and Glamorgan and Pembrokeshire both possess valuable kinds of labouring cattle, the latter of which are considered as active as most horses. They are, indeed, said to follow them, let their pace be what it may, trot or gallop; and the expedition these teams use in conveying coal and culm to the ships, on various parts of the coast, which must be always loaded during one tide, never fails to strike with equal wonder and compassion a by-stander not used to such rapid driving as is usually exhibited upon those occasions*. Of these, however, the distinct breeds, though prevailing in general character, yet have been so much crossed, that opinions are as much divided regarding their several degrees of merit as upon any other subject of local prejudice. It is, indeed, but natural that men should be partial to the stock which they have been in the habit of rearing, and even supposing any one to be so impartial as to admit the superiority of another breed, there may yet be found objections to its employment in the difficulty with which such new stock would either be replenished, or disposed of, in his immediate neighbourhood. Men are also governed by so many different considerations in the choice of cattle, some wanting them for grazing, and others for the stall or the plough, that it would require more room than we can afford to discuss their several qualities; a detail of which is besides unnecessary, on our part, by the ample and accurate description which will be communicated to the public in that portion, now publishing, of the Farmer's Series of the Library of Useful Knowledge, which will be devoted to the subject of horned cattle.

We shall therefore merely remark, that the Sussex heavy breed—for there is a lighter variety—is a slow and powerful worker, of a very quiet and domestic temper, and so steady a puller, that he will draw nearly or quite as great a weight as almost any horse that bears any degree of comparison to him as to size; and will perform as heavy work, on either road or field, on the alternate days—thrice a week. He is, however, a slow feeder; but, when moderately fattened, his weight, though inferior to the improved short horns, will average 130 to 160 stone; he is therefore decidedly a favourite working animal, and is, in consequence, kept by many farmers to ten years of age before fattened †. Their greatest objection, besides the slowness of their growth, consists in carrying too great a proportion of their weight on their coarser parts; a defect which is also attributed to the Hereford breed.

The Devonshire ox, though not so large as the heavy breed of Sussex, nor yet quite equal to him in strength, is yet superior in agility. He is a freer worker, and a kinder feeder; so strong in constitution as almost to support a fair state of condition in a straw-yard. He also comes to the yoke at an earlier age than any other breed. He is somewhat lighter in colour than the deep Sussex red, and more handy in size and sightly in form; his temper is of the very first order, and, in most points of docility, he bears a close comparison with the horse.

Except the superior Hereford cattle, the other breeds, if well bred, or purchased with common caution, will generally be found to go through

* Hassall's Pembrokeshire, p. 19. Survey of South Wales, vol. i. p. 293.

† See p. 188. One is also said to have been slaughtered at Bromley, in December, 1829, that weighed 232 stones of 8lbs.—Herbert on Bullock Husbandry, Brit. Farm. Mag. No. xv. p. 183.

their work with more equality than fashion may seem to suppose. But they must be well kept; for it is not to be imagined that if fed on straw, neglected, and filled with dirt and vermin, they can be supported in spirit and condition. 'Their labour and their fodder ought to be so proportioned that their health and their spirits be kept in full tone. Their coats ought to be sleek; their hides loose and silky; the flank should fill the hand, and the shoulder handle mellow. If they be over-worked, or under-fed, disease and sluggishness must inevitably follow. A working-ox ought always to be in such condition, that, in case of accident, he may grace at least the poor man's table. He should be handsomely made, deep-chested, straight and clean limbed, full shouldered, active and spirited *.'

In Scotland, we have already seen, that oxen are but seldom used in the plough. Although rather more extensively employed in some parts of Ireland, yet those kept for labour are chiefly in the hands of gentlemen, or of farmers who unite the different branches of grazing with farming; but the winter keep allowed by the latter is generally of the most inferior and penurious kind, and but little attention has been paid to their comparative qualities as working cattle. It has indeed been well observed by the reporter for the county of Kerry †, 'That gentlemen of property, who import and improve stock for their own advantage, and that of the county in which they live, have some difficulties to encounter, exclusive of prejudice, which is the chief bar to their exertions. In arranging the prices of breeding-stock, much consideration is required; if this be too high, none but amateurs will purchase; if too low, the breeder is disappointed in a fair return of reasonable profit, and the character of the stock is brought into disrepute. Some medium between fancy and a market price should be struck off, which would secure the seller from disgust and loss, and the purchaser from a too speculative bargain.'

The training of steers, for work, is very rarely committed to any other than the breeder; the animal is found to be more docile, and to thrive better in its own home than in any other, and its sale, for the purpose of labour, is less an object of speculation than that of the horse. The calves are dropped in the ordinary season, and either weaned immediately or allowed to suck, according to the system of grazing pursued on the farm, nor does it appear to materially affect their future thrift or health; but for weaning, they should fall about December, and if kept warm in the pens until gradually released from housing, they will be equally forward with calves dropped in the early part of spring which run with the cow; though the March calf is reckoned the best ‡. They are fed about the orchard, or in a spare paddock, until late in the spring or summer, and then turned to grass until the approach of November, when they are taken into the yards and fed on such food as can be best spared; but it must be remarked, that on the quality of this will greatly depend their growth and condition, for although a half-fed animal may grow large, he will assuredly become gaunt and awkward, ill set in his limbs, and defective in his shape; he will also come later to the yoke, and, consequently, a portion of his labour will be lost. Though hay may be only given in very moderate quantity to yearlings, yet they should have an allowance of oatmeal and bran, with plenty of roots as well as straw, and although confined to the shelter of the yards and open sheds at night, they should be allowed the run of the pasture in day-time, whenever the weather permits.

* Marshall, Minutes of Agriculture, Digest, p. 49.

† The Rev. Thomas Radcliff.

‡ Vancouver's Devonshire, chap. xiv. district 11.

They are then again turned out as soon as there is a bite of grass in the spring, and the same course followed—with the exception of the meal—until rising three years old, when they may be gently used just to accustom them to the yoke or collar, and are regularly put to work in the spring of the following year. When broken very young, they become more docile and tractable than when kept to a greater age; they are also thought to apply their strength with more effect to the draught, and, if properly taught, their common natural pace may be certainly much improved. To accustom them to a quick step, they should, however, be at first driven with a very light weight, and should not be heavily laden until they have attained their full growth.

The patience of the ox is proverbial, but, though more quiet than the horse, he is yet of various temper, less tractable, and sometimes very indocile; his strength too, though of the same breed, is often very unequal, and therefore considerable attention is requisite to match them. The training, though generally considered an object of great difficulty by those not accustomed to their use, is, in truth, one of the very simplest nature. The great point is to govern him by mildness, and by gentle usage to accustom him gradually to his work, without apparent compulsion or severity; for, if irritated, an impression may be made upon his temper which no after treatment will efface; but with kindness he is easily familiarized and rendered docile. A young steer should be accustomed from the earliest age to be driven about and led; he should be also occasionally handled when about the yards, and when taken up for the purpose of breaking, he should be placed under the hands of a careful steady man of particularly good temper, who should commence by feeding and caressing him. In this process also, a good deal of care and management is requisite, for young stock will not always eat of the food that is presented to them: in some cases, indeed, hardly any thing but sheer hunger will induce them, and if stinted, they will suffer in their health; but if the steer cannot be coaxed by other means, the better mode will be to turn him for a few days among older stock already accustomed to other food, from which he will soon learn to consume it. He then should be tied up in the ox-house, and used by degrees to either the yoke and bow, or to a bridle and collar, until gradually accustomed to the gear, when he should be harnessed to a tame old ox, which is made to accompany him gently, without forcing him to his work, and if he offers resistance, he must be patted, encouraged by the voice, and fed; if very obstinate, he should suffer hunger, and only be fed after work: he will thus be taught to obey his master, but it should rather be by firmness than by violence. After patiently pursuing this course for a few days, his objection to work with the other oxen will be overcome; his labour, however, must be very gentle; he should neither be fatigued nor over-heated, for if hurried in hot weather he may be exposed to the flux.

Cleanliness, though not so essential to oxen as to horses, should be also attended to; his feet and legs should be well washed, and his coat be wisped over after he has worked; and this kind of care, though too commonly neglected, will tend to keep him in spirit and condition. He should then form one of a pair, which should be yoked together; or, if there be a pair of well broken-in oxen upon the farm, the most advisable plan is to yoke the young ones behind them; and as the spring is the usual time of doing this, they may be attached to a molding-sledge, or bush-harrow, upon grass-land, and thus be made in a slight degree useful even in the breaking. After two or three trials in this way, they may be put to harrowing fallow-ground; but for the first few weeks it is generally

found advantageous to let them follow older oxen. When thus broken-in at two years old, they give very little trouble, and become gradually accustomed to every kind of work. It is, however, to be understood, that oxen are unfitted for much labour until they have reached their third year; therefore, until they are thoroughly trained, they should only be employed at short intervals; but it is from that period, until they are six years old, that they are most active and useful in the draught. By this time, too, they will have fully attained their growth, and their value, instead of increasing, would be lessened, as they fatten more readily before seven years of age than they do after it, and make finer beef. It is generally observed that, although aged oxen have the advantage in strength, yet the younger ones are decidedly preferable for all light work, which requires more speed.

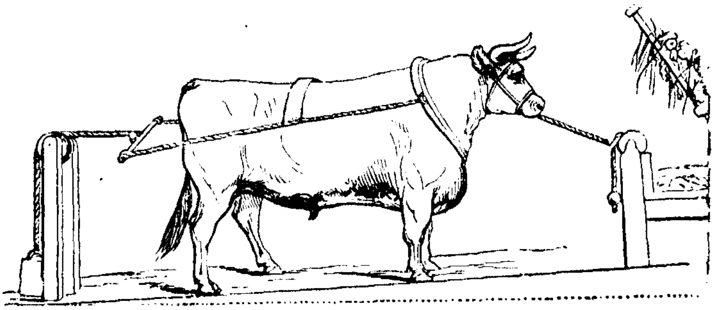
On farms where oxen have not been already employed, the young steers may be very readily broken-in to work by having an old steady horse put before them. We cannot, however, but advert to a common practice, which, though prevalent chiefly among small farmers, is yet by no means unusual on many larger concerns—of pairing horses or mules together at the same work with oxen, which, of all the preposterous customs ever sanctioned by ignorance, seems the most absurd. A sluggish ox is thus sometimes coupled with an active horse: at first the latter exhausts his strength, but at length, finding his advantage in moderating his pace, he adopts the slow step of the former, and, having once acquired the habit, it soon becomes fixed, and he suffers great injury in his value. A single horse is in that manner often added, either as a wheeler or a leader, to a pair of oxen, from an idea that such a mode of draught is more handy than when oxen are employed alone, but it is a custom which no plea can really excuse *.

Oxen, though usually worked in pairs, are yet often used in double couples, and driven by a boy, whose chant, which is continued with unabated ardour throughout the day, the ploughman throwing in at intervals his hoarser notes, is in many parts of the country thought to have a very peculiar charm in cheering them on to their labour †. Nor is the lad's time thus wholly thrown away, for he must himself learn to drive and hold, and the expense forms but a trifling additional charge upon a team.

There is also another, and a very simple mode adopted by many foreign farmers to induce obstinate steers to take kindly to their work, without either loss of time in attendance or unnecessary force, and merely by acting upon their appetite. According to this plan the animal is harnessed, and fastened by the collar to a cord or chain, which runs in a ring, to which a weight is appended at the manger, which he can approach or retire from at pleasure. Another weight is then hung to his traces by the centre of the splinter-bar, and rests upon the ground, passing through a pulley upon which it moves. The weight to which the steer is thus attached may be about a cwt. or more, and he is then placed at the full length of his chain from the manger, which is filled with provender, and he cannot approach to eat without drawing the weight after him. In this manner he soon accustoms himself to move the load, and in the course of a fortnight he will probably be tamed without further trouble, of which the following sketch will afford a clear idea:—

* See the Surveys of North and South Wales, of Hereford, Devon, Sussex, Kent, and of most of the Irish counties, *passim*.

† Marshall's Rural Economy of the West of England, vol. i. p. 116.



The following system of breeding and working stock, keeping cows in proportion to the working state of the oxen, and rearing the calves which are brought into work in succession, and turned off to the grazier after three or four years' labour, has been recommended, and may be found useful; the number, of course, depending on the means or inclination of the breeder.

6 bull-calves, } 2 of each of which, that is, 6 together, being sold or other-
6 year-olds, } wise disposed of, in order to admit of the proper selection
6 two-year-olds, } of the working stock.
4 three-year-olds, beginning to be worked.
4 four-year-olds, at full labour.
4 five-year-olds, at do.
4 six-year-olds, fattened off at the end of harvest.

Thus twelve oxen are worked in common, at full labour, from three to six years old; but if only one yoke of four is kept, and worked, suppose for four years, more cows are required to produce a regular succession of calves than the usual number, for only one bull-calf is necessary; but as steers can only be worked, with any degree of propriety, in pairs, two should be produced, and every second pair sold.

The plan pursued by Mr. Ellman, of Glynde, in Sussex, consists of—

14 calves, of which nine are male—eight for oxen, and one allowed for accident, or for not taking to work.
14 year olds.
14 two-year olds, of which eight are worked a little at two years and a half.
14 three-year olds, part of which are taken for cows, and others, if not good, are fattened.
14 four-year olds, eight worked.
14 five-year olds, do.
14 six-year olds, fattened off.

Thus twenty-four oxen are employed—eight three, eight four, and eight five years old; and a reserve is kept for breeding cows and accidents *.

That of an Anglesey farmer, who works twenty-four oxen, is also thus stated in the Survey of North Wales. His plan is to sell out eight oxen every year, at six years old, and to take in the like number of three years old, which are trained by the remaining sixteen very soon, and much easier than if the teams had consisted of all fresh ones. When the young ones are taken in to be trained, six are worked in a team for awhile; and, by putting the fresh pair in the middle, they are soon tamed. The oxen all

* Survey of Sussex, p. 261, in which also there may be found a detail of the system followed by Lord Egremont, at Petworth, p. 263. See also the Library of Useful Knowledge, Farmer's Series, on Cattle, No. 11, p. 45.

work three years: the elder eight are taken out every May, and kept in good grass until September, sometimes October, when they are half fat.

Another, in South Wales, also, generally works twenty-four oxen in yokes after barley-seed time, he turns the twelve elder to grass, having the preceding Michaelmas yoked twelve of his steers in their stead, and so on annually and systematically *.

A mode of training and working oxen, which has been successfully adopted in Angusshire, we give in the words of the farmer by whom it is practised.

'Out of my stock of cattle I select, when two years old (that is, after harvest, when they are rising three), four of my stoutest, best-shaped stots from the field. These, to accustom with harness, I bind up in my oxen-byre every night for a week or two; and they are then taken out in pairs, and put into the plough with a pair of older trained oxen yoked before them. This keeps them steady and prevents their running off. After being yoked in this manner two or three times, I turn them again amongst the cattle in the straw-yard, where they remain until spring. They are then three years old. I yoke them all four (after training them as above stated) in a plough by themselves, which requires a little boy to drive; and in that way they are used until four years old, when they are worked in pairs, as horses, by one man only, and do the same work at ploughing: for at carting I never use them, having as many horses as do that part of my work. When used in pairs, one man works two yokings, and the cattle only one each. If, however, eight stots were worked, *four and four alternately*, it would be a great relief; and I have uniformly found that cattle moderately worked thrive better than those that are idle or unemployed.

'In summer they get nothing but pasture-grass, being turned into the field after the work is performed, and continue there until the working hour returns. In winter they are fed like my other cattle: that is, they get a feed of turnips once a day, with straw; and in this way do my young steers consume my turnips, for I do not fatten any for the butcher. In the spring season only I am obliged to substitute hay betwixt the time when my turnips are consumed until the grass comes up †.'

In regard to the general period of commencing breeding, cows should not produce calves until three years old, but they are very commonly dropped younger. A bull may be first used at eighteen months old, or even younger; and, from a notion that his vigour becomes impaired at two or three years of age, he is commonly put out of use by that time; though it is probable that his constitution would be stronger, if well preserved, until six or seven years old: but their powers are weakened by unlimited use.

SHOEING.

Connected with the subject of draught is a serious objection to the use of oxen for road-work, arising from the difficulty of shoeing them. The solidity and round form of the horse's hoof resists, without inconvenience, a force which would divide the claws of an ox asunder; great care ought therefore to be employed in the operation, and yet it is usually performed in a manner the most slovenly and imperfect. The best mode is to make the shoes very thin and broad, covering great part of the foot, and rather turning up at the toe between the hooves; they should be then fastened on with broad flat-headed nails, covering with their heads great part of the

* Surveys of North Wales, p. 339; of South Wales, vol. i. p. 290.

† Farmer's Magazine, vol. iii. p. 450.

The process of fermentation likewise requires extreme care, and is an object very imperfectly understood. It is often confounded with that ebullition, or hissing noise, which may be noticed when limestone or other alkaline matter is mixed with vinegar or other acids; but this effervescence is merely occasioned by the escape of fixed air (carbonic acid gas), and though the word 'fermentation' may be retained in compliance with common usage, it has nothing in unison with those operations which are properly termed the *vinous*, the *acetous*, and the *putrefactive fermentations.*

Of these, the first causes the sweet materials to become spirituous, though the latter quality applies more particularly to the juices of fruits; the second occasions a sourness, which in liquids produces vinegar; and the third is productive of putrefaction.

During the process of fermentation, as applied to manure, it heats, after more or less time, according to its contents, and at last it is converted into mucilage and salts. The latter part of this operation is the most important, for it requires great care to ascertain, by mixing the whole mass well together, that every part of it is in the same state of fermentation, lest some parts of it should reach the last stage—which produces salts—before the other portion has become mucilaginous,—an accident which frequently happens when lime is laid among dung without being well mixed throughout the heap, by which much of its benefit is lost, as it acts as a stimulant, and becomes hurtful if not used in a very small proportion.

The materials of which the first-mentioned of these manures are chiefly composed are stable-dung and litter, urine, night-soil, and all weeds or other vegetable substances which can be converted into muck, together with the putrid remains of animals and fish—which may be all classed under the common name of *putrescent manures.*

Then chalk, lime, marl, gypsum, shells, ashes, soapers' waste, and burnt clay, which, being fossil, or of the nature of fossil substances, fall under the denomination of *mineral manures.*

And lastly, green crops ploughed down, as well as the various articles made use of as top-dressings and composts, which may be generally designated as *miscellaneous manures.*

These will become the subject of separate chapters; but it is not proposed to enter into any philosophical discussion regarding their powers, the consideration of which will be confined to a practical view of their nature and operation. The farmer who has a large portion of them at command will find in their alternate and judicious employment the certain means of increasing the usual products of the soil; and his success, as a husbandman, will doubtless be in proportion to his intelligence, and to the attention bestowed upon its cultivation. The importance to be attached to an acquaintance with the principles of vegetation, and the application of manures, cannot therefore but be sensibly felt by every man who sets a due value either upon his character for ability in his profession, or upon his pecuniary interest; and, with the intention of facilitating its study, we add a brief explanation of the common terms employed in this branch of chemistry. Our object, however, being merely to be useful to persons who are strangers to that science, and being aware of the prejudice already existing against it in the minds of those who are uninformed of its value, we have abstained from anything beyond a slight sketch, or from employing any other than those phrases which may be rendered easily intelligible to persons of the plainest education and understanding.

CHAP. X.

ON PUTRESCENT MANURES.--FARM-YARD DUNG.

PUTRESCENT manures, as we have already seen, consist of all animal and vegetable substances which can be reduced through decomposition, fermentation, and putrefaction, into such a state as will render them fit to assist the melioration of the land, and to forward the purposes of vegetation. When combined, they form a saponaceous, solid mass of great nutritive power, well known to farmers under the common term of 'muck;' which, although a seemingly uncouth expression, conveys an idea distinct from that which is meant by dung. Of these, the most generally useful are composed of the excrements of animals; for that which passes through them is not composed alone of the residue of their food, but also of certain secretions of other matter in the intestinal canal, so that the dung, even of those which are supported entirely on vegetables, partakes more of an animal than of a vegetable nature. The food on which they are supported, and their state of flesh, also make an essential difference in the quality of the manure. If the stomach of an animal be filled with provision which contains but little nutriment, and which is composed of fibrous matter which it is difficult to decompose—for instance, straw alone, without grain—this will pass through the intestines in almost the same state as it was eaten. The dung will contain less of that secretion which belongs to animals whose flesh has not been deprived of its nourishing juices; though even this small quantity serves to give the straw a stimulus to putrefaction. But the excrement of animals which have been supported upon nutritive food—as corn and pulse, or the oleaginous seeds of rape and linseed, though given in the shape of cake—and which are thus maintained in high condition, imbibes much of that property to which we have alluded, which thereby yields a more fertilizing manure than that furnished by lean stock. This, indeed, is strikingly exemplified by the difference observable in that produced by stall-fed cattle, and those kept in the straw-yard; and there can be no doubt that the fatter the animal the richer will be its dung.*

It has been thought that the dung of ruminant animals—oxen and sheep—when pastured, is preferable to that of horses, also kept at grass, which is supposed to be owing to the greater quantity of animal juices secreted with their food in the act of chewing;† but the fact requires to be established by a more minute and critical analysis of its properties. All animal manure, however, partakes in its fertilizing properties of the richness of the food by which it has been created; yet experience proves that its immediate powers are in several instances widely different. Thus the ordure of a man and that of a dog, though fed upon the same food, is so wholly distinct in its effects, that the excrement of the latter is used instead of bark in the process of tanning goat-skins for the production of morocco leather. Pigeon's dung, too, is hotter than that of other fowls,‡ though both are fed alike; and it is said that a celebrated foreign chemist—M. Vauquelin—has not only lately discovered a very remarkable difference

* It is stated in the Norfolk Report, that 10 loads of dung from cattle fed upon oil-cake, have been found to answer as well as 16 from beasts fed upon turnips.—p. 420.

† Outlines of Agriculture, by A. Hunter, M.D., F.R.S., &c., p. 11.

‡ By an experiment stated in the Agricultural Magazine, it was found that the dung of hens was found more effectual than that of ducks; while that of geese was scarcely perceptible as manure.

between the dung of cocks and hens, but that there also exists a sensible distinction between that of hens which lay, and of those which do not produce eggs! However deserving those researches may be of inquiry, and however important they may hereafter prove, if followed up with regard to the larger animals, it would yet be difficult, and perhaps, under all circumstances, unnecessary, to state the differences of the comparative character and value of these and various other putrescible bodies—such as fish, spoiled flesh, and many other substances, which, though all, no doubt, useful to vegetation, when they can be procured on such terms as that the farmer finds they can be profitably applied to his purpose, are yet seldom found in such abundance as to require a separate account of the properties of each. We, therefore, do not deem it necessary to pursue that portion of the subject farther, and shall accordingly proceed to the consideration of that compound of vegetable and animal substance so well known under the title of

FARM-YARD MANURE.

This must ever be ranked in the first class; and when improved yards have been constructed for the soiling of cattle, and attention has been paid to the quality as well as the increase of their dung, the manure thus produced becomes of inestimable value. No husbandman can carry on his business without it, and every one who attends for a moment to the difficulty of procuring a sufficient quantity of dung, as well as of preparing what is got, will acknowledge, that however imperfectly the subject be understood, none is more deserving of serious investigation; yet even the most superficial observer on the common state of culture can hardly fail to remark, that the evident inattention to its management is such as would almost lead to the supposition that it is not worth the pains of the farmer's care. Nothing is more common than to see large heaps of manure thrown out from the stables and feeding-sheds, and exposed in that state to the weather, without any regard to its being either laid up in a regular and careful manner, secured from evaporation, or carefully mixed in different proportions according to its various qualities; yet these proportions are severally of a very distinct and important nature

When *horse-dung* is sufficiently moist, and is exposed to the action of the air, it speedily enters into a state of fermentation, which is necessary to mix and assimilate its watery, oily, and saline parts; but if care be not taken in that process, it exhales so much heat that it soon becomes dried up, its volatile particles are evaporated, and it easily crumbles. If the parts of which it is composed are not also so compactly heaped as to exclude the air, they become likewise unequally decomposed, grow mouldy, and the whole mass is thus deprived of much of its fertilizing power. If, however, the natural moisture be retained, or it be regularly and moderately wetted, it acquires almost the consistence of a paste, or that state which is called *spit-dung;* and if it be laid upon the land before it is entirely decomposed, its effects upon vegetation are prompt and powerful; which is partly to be attributed to the heat which is developed anew, when, after being ploughed under the soil, its decomposition is completed. This occasions it to act with singular efficacy upon lands which are cold and clayey, the faults of which it tends greatly to correct, and the soil is much benefited. It also greatly improves land which abounds in vegetable mould, because the ammonia contained in the manure favours its decomposition.

When completely decomposed, and thus reduced to the condition of *rotten dung*, it is much lessened in quantity, but that residue contains the essential part of its substance, which is highly favourable to vegetation on land of every kind with which it is incorporated. In this state, however, it is often productive of bad effects upon dry, sandy, chalky, or other light and calcareous soils; for there it stimulates the plants too powerfully at the first period of their growth, so that when the action of the dung has ceased, vegetation becomes languid; in corn crops great bulk of straw is produced, but the grain is apt to be deficient. It is also less durable, because it is consumed by the excess of its own fermentation, and its powers being thus exhausted, it has but little effect upon the future crops on such land.

The *dung of horned cattle* also soon ferments when it is collected into a heap, and is only moistened by its own humidity; but this process is slower than in the dung of horses, because it is not so much exposed to the same internal heat, in consequence of which the evaporation is less, and being ordinarily voided in a very moist state, it does not require to be wetted. Neither is it subject to crumble; but it rather becomes a mass of unctuous substance, which it retains until its moisture is entirely exhausted, when it assumes the appearance of dried peat, or turf, and, when not well mixed with the earth, it is found in the land in clods sometimes so long as two or three years after it has been laid on. Its effect upon the soil is slower than that of horse-dung: it has been also considered more durable; but, as we have already observed, this latter effect must in great measure depend upon the nature of the food by which it has been produced. Whatever may be the degree of fermentation at which it has arrived, it does not seem to occasion any perceptible heat when laid upon the land, for which reason it is best adapted to dry and warm soils. Thus, upon sands and gravels, which, from their nature, are apt to be hot, its cooling qualities counteract that effect, and upon such land it has been found of infinite service; but upon strong clays, it appears to be nearly inoperative if buried under the ground, and not exposed to contact with the atmosphere by repeated ploughings. When used alone, it has, however, been considered, in most instances, as nearly worthless *; and the most advantageous mode of employing it is to form it into a compost with the other contents of the farm-yard. It has also been thought that the dung of milch cows is inferior to that of oxen †; but this can only be attributed to their yield of milk, which probably deprives it of some portion of its richness, and when they are dried off and fattened, there is no perceptible difference.

Sheep-dung decomposes quickly when it is moist and compactly heaped together; but when dry and dispersed, its decomposition is slow and imperfect. Its effect upon the soil is soon dissipated, and is generally exhausted after a second crop. Much ammonia is disengaged from the excrements, and more especially from the urine of sheep, and this renders their manure particularly valuable upon soils which contain insoluble mould.

* An instance is mentioned in the Essex Report of 15 acres having been manured for beans—6 with horse-dung, and 9 with dung from the cow-yard; and that the 6 acres produced far more than the 9.—Vol. ii. p. 230. In an experiment made near Grantham, in Lincolnshire, on a poor dry soil, the manure from a horse-yard, and that from a yard where neat cattle were wintered, were used separately for turnips, and the former was found to have greatly the advantage.—Sinclair's Code of Agriculture, 3rd edit., note, p. 214.

† Bedfordshire Report, p. 509.

That which is found on the floor of sheep-cotes, when left undisturbed, is of two qualities—that of the upper layer, which is occasionally renewed with fresh litter, being strawy, dry, and not fermented; while, on the contrary, that of the under layer is moist, clammy, and fit for use. When the dung is removed, care should therefore be taken to mix both layers, so that they may be equally decomposed; and, when thus prepared, the manure should be spread sparingly upon the land, if used for corn crops, or it is apt to make them run to straw: but upon cold, sour soils, this unfermented dung may be used in large quantities with considerable advantage. The most usual way of procuring it, however, is by *folding*, under which head it will be separately treated when we come to the subject of sheep. Here, therefore, it is only necessary to remark, that it appears, from an experiment on record, that 134 ewes and wethers, with 30 lambs, were penned during six weeks in a sheep-cote, and littered with one load of straw per week, which produced 28 large loads of dung: thus—

	l.	*s.*	*d.*
Valuing the dung at 7*s.* 6*d.* per load	10	10	0
Straw, at 69cwt. 1qr. 20lbs. at 20*s.* per ton, or about	3	10	0

this would leave 14*l.* for the manure. But these sheep consumed the produce of two acres of drawn turnips; in which time, according to all common calculation, they would have folded two acres, without the expense of either taking up the crop, or of spreading the dung*. In another standing fold, containing an English acre, the plan adopted was to spread the straw a foot deep, and strew turnips upon one-half of the fold every two or three days alternately, until the litter became wet, when it was again covered with fresh straw: the sheep thus lay very dry; and in this manner, it is said, that, in the course of the season, 800 tons of the best manure upon a farm in East Lothian was produced by 308 wethers! The quantity, indeed, appears so very extraordinary as to seem almost incredible, and had it not been stated on the respectable authority of Sir John Sinclair, we should have hesitated to afford it insertion †: but—though not so stated in his account—it is probable that the fold was also deeply bedded with sand.

Swine's dung is, by many persons, considered as the richest of all animal manure, except night-soil; while others view it as being of a cold description. It is of a soapy nature, is slow of fermentation, and when laid upon very cold soils, it should be mixed with horse-dung; for although its stimulating powers upon vegetation are very great, yet of itself it does not heat sufficiently to destroy the seeds of weeds. Mr. Malcolm, indeed, says that 'he has often seen it applied to land consisting of a shallow loam upon a fine gravel, and land of a sandy nature, in which soils it has filled the ground with weeds, particularly the May-weed; and in a hot season a crop of barley has been entirely burnt up ‡.' The loss of the barley-crop may however be partly attributed to the dryness of the season, and the foulness of the land to the want of good culture. Any ill-managed manure may be full of the seeds of weeds, and therefore they may be sown with it. But it is a futile charge against any species of manure to say that it encourages weeds, for it is evident that, if the land were clean, the same stimulus which acts upon them would be applied, in like manner, to the crop of grain intended to be cultivated. We do not

* Complete Grazier, 5th edit. p. 253.

† Husbandry of Scotland, vol. ii. App. p. 47; and Gen. Rep. of Scotland, vol. ii. note p. 511.

‡ Survey of Surrey, Kent, and Sussex, vol. ii. p. 27.

hear such complaints from farmers who drill their corn and effectually hoe the intervals. When, therefore, it is considered that vast quantities of weeds are usually cast into the pigsties, many of them bearing seeds fully ripened, it will be evident that caution is requisite to destroy their vegetative powers before this manure is laid upon arable lands. On this account, nothing can be more proper than to form a dunghill by a mixture from the pigsties and the stable. The well-known property of horse-dung to ferment freely will completely effect what is required, and the compost will be found most valuable. The worth of manure from the pigsties will however depend much upon the mode in which it is prepared. If the litter be often renewed, and it be kept dry, either by sloping gutters, or by means of holes bored in the planking of the floor, then the straw will retain but a small quantity of the urine, and will be productive of little other effect than if it were merely rotten. But if it be allowed to become saturated with the urine, by stopping those drains, and care be taken to preserve the litter in a proper state for decomposition, it will ferment rapidly, lose its coldness, and become a very strong manure. The necessity of cleanliness in the stye is a consideration apart, which belongs more properly to the future subject of the treatment of hogs.

A full stock of swine effect very great service when permitted to run loose in farm-yards where much straw is used; they highly enrich it by their dung and urine, and mechanically promote the decomposition of its woody fibre by the manner in which they constantly work among it,—breaking it to pieces, and thus rendering it more manageable on arable land, even when in the earliest stage of decomposition. They have, indeed, been strongly recommended by Mr. Blaikie, who advises, in his very judicious essay on farm-yard manure, 'that those industrious and useful animals should be attracted to the yard, because they rout the straw and dung about in search of grains of corn, bits of Swedish turnips, and other food, by which means the manure becomes more intimately mixed, and is proportionally increased in value*.' Great inconvenience has, however, arisen from allowing them to run about the buildings, through the difficulty of preventing them from getting out and damaging crops and fences; wherefore many farmers have adopted the plan of having paled yards, with open sheds, for the sole purpose of keeping their store pigs.

Urine, although essentially composed of water, yet contains much of the elements of vegetation in a state of solution peculiar to itself, and is combined, through the secretion of the vessels, with carbon and saline matter, from which it derives its nutritive properties, as well as with a large portion of ammonia, to which it owes the peculiar smell by which it is distinguished. The various species of urine from different animals differ in their constituents, and the urine of the same animals alters when any material change is made in the nature of the food †. The analysis of its composition has shown it to be most favourable to vegetation when mixed with other excrement, and with straw or similar substances, because it occa-

* Edition of 1828. p. 12.

† By experiments made by Mr. Brande on 100 parts of the urine of cows, and by Fourcroy and Vauquelin of horses, the following proportions were found in each, viz.:—

COWS.		HORSES.	
Phosphate of lime	3	Carbonate of lime	11
Muriates of potassa and ammonia	15	do. of soda	9
Sulphate of potassa	6	Benzoate of do.	24
Carbonate of potassa and ammonia	4	Muriate of potassa	9
Urea	4	Urea	7
Water	65	Water and mucilage	40

There is, therefore, more alkaline salts in the urine of horses, which consequently

sions their combination, and contributes to their more perfect decomposition, by which they are converted into the species of manure of which we are treating; and although we confine that manure to straw, or haulm, and to the dung of horses and oxen, both as that of which it is the most generally composed, and as folding and night-soil will be separately considered, it yet includes every other kind of ordure.

Straw of all kinds, or similar dry vegetable matter, when used as litter, is well known to form a principal ingredient in the composition of farm-yard manure; not perhaps so much by the nourishment which it is of itself capable of imparting to the soil, as from the value which it acquires by its absorption of urine, as well as by combining with dung in its different stages of decomposition, and imparting consistence to the whole mass, which is then carried more regularly through the processes of fermentation and putrefaction, by which it is rendered fit for the purpose for which it is wanted. Nothing, in fact, can be better adapted for the mixture than straw; for it would rot with difficulty and imperfectly but for the dung, which brings an accession of the richest materials to the heap, and there can be no doubt that, when thus combined, it forms the best and the most generally useful of all manures for every kind of land. All the various sorts of straw and haulm answer the purposes of litter, though opinions vary respecting its value for that use; some contending that rye straw is the best, while others insist, with more apparent reason, that the straw of wheat absorbs more moisture, and it is supposed to be equal to three times its weight after it has been saturated with urine.

It was the system of Bakewell, during a part of his life, to convert the whole of the straw into food for his stock, and it was also the opinion of many of his supporters that this mode of consuming straw would not only tend considerably to increase the number of black cattle, but also to improve the quality of manure; for they argued—'that straw is not alone thus rendered fit for the support of live-stock, but that, by being digested and passed through their bodies, it must become a much more highly-enriched manure than in the ordinary way of treading and rotting.' Bakewell, however, altered his opinion at a later period of his life, and the doctrine is certainly questionable; for although it be true that a part of the straw, when eaten, assists the fermentation of the remainder, yet, when partly used as litter, it at once absorbs the urine, which is perhaps of more value, as manure, than straw which has been merely masticated and digested, without being combined with richer food; and it is yet very doubtful whether, if all the straw in the kingdom were to be passed through the intestines of animals, the manure made from their dung would not be thereby

possesses greater fertilizing powers than that of oxen; and it has been not inaptly demanded, whether, if these ingredients could be procured cheap, and rendered soluble in water, they might not be so prepared as to become valuable for saturating dunghills, or for application in its liquid state?—*Leicester Report*, note, p. 190. Human urine contains a greater variety of constituents than any other species, and differs in comparison according to the state of the body. All urine is liable to undergo putrefaction very suddenly; but that of carnivorous animals more rapidly than that of granivorous animals. The pot-ash and pearl-ash of commerce are carbonates of *potassa*, of different degrees of purity.—*Sir H. Davy, Elem. of Agric. Chem.*, p. 256. See also the Analysis, by *Berzelius*, and by *W. Henry, M.D., F.R.S, Elem. of Exper. Chem.*, 10th edit., vol. ii. chap. xiii. sect. v.

The white globe turnip not only yields a larger quantity of urine, but its effect as a manure upon any crop is less apparent than that of either the yellow Aberdeen or the Swedish. That produced by cut-grass is comparatively weak; but the liquid manure from the refuse of distilleries, such as grains and dreg, has been found good.—*Quart. Jour. of Agric.*, No. xix. p. 96.

reduced both in quality and quantity. The practice differs in various counties: in some parts of Yorkshire, and other places, a farmer commonly makes his cattle eat almost every particle of straw, leaving scarcely any to litter their stalls; while in Norfolk, they convert nearly the whole into muck, and no system is considered more impoverishing to land than that of applying the straw as food instead of treading it into dung*. The medium course is doubtless the most to be approved when it can be conveniently carried into effect; but there are many farms which either do not produce turnips, or only sufficient for their sheep, by which they are eaten off upon the land, and corn or oil-cake being too expensive for store and working stock, they must necessarily be chiefly kept upon straw. It is therefore profusely used for store-cattle in most yards, yet, by having abundance, they pick out the best and leave the refuse for litter: it is only necessary to supply it fresh, with a moderate quantity of turnips, or any succulent root, to promote the secretion of urine, and the manure thus produced will be found of excellent quality; but if they be wholly fed on straw, although the farmer may have a large dunghill, it will be found to be of comparatively little value.

It has been thought that cattle getting wholly straw, or other dry forage for both food and litter, may consume nearly three-fifths of it as food, and there would still remain a useful mixture of dung and straw for manure. When they are supplied, as young or keeping stock, with turnips to keep them merely in condition, the manure will be in good order when they eat about one-half of the straw, and leave the other half as litter. If again, they are being fattened on turnips, or fed on distiller's wash, grains, or upon other food, which produces their dung with much urine, they would then require to have at least three-fifths, if not a still larger quantity of straw left for litter. These proportions will, in such instances, be generally found to produce manure of a good description; but when beasts are fatting upon steamed potatoes and oil-cake, or other provender which occasions costiveness, or does not occasion a free discharge of urine, it may sometimes be necessary to moisten the dung-heap, by which means any quantity of straw may be rotted, and, with a comparatively small proportion of dung, may be converted into manure †. Mr. Marshall mentions having tried the effects of moisture in some experiments on his own farm upon heaps of dung which had lain until much of it had become mouldy, one of which he watered, bringing the outward and dry parts into the middle of the pile, and drenching it well with the drainage of the yard; it was then carefully turned over, breaking every lump and mixing all its parts, then finally wetting the surface, and clapping it smooth and close with the back of the shovel to keep in the heat. It began to work on the second or third day, after which the mouldiness disappeared, and it was converted into comparatively rich, black, and rotten dung; and other similar trials were equally successful ‡. The utility of that point of management is, in fact, unquestionable: the trouble is not worth mentioning; but were it greater, and that any thing is to be thereby gained in the quality of the dung, that can form no sufficient excuse for its omission, for, if it be of any value, it cannot be too good, and the experience of kitchen gardeners, who are well known to use great care in the preparation of dung, and to profit accordingly, should operate as a hint to farmers to use similar means.

* Young's Survey of Norfolk, chap. xi. sect. 3.
† Quart. Journ. of Agric., vol. xi. note, p. 335.
‡ Marshall's Rural Economy of the Midland Counties, vol. ii. pp. 95, 120.

There can be no doubt that the *haulm of beans and peas* produces more nutritive food than straw. When the former is well broken by thrashing, it also forms a very tolerable litter, for which purpose it is much used in most parts of England, though in some places it is wholly laid, as if of no further value, in the bottom of the straw-yard, and pea-haulm is more generally employed in cart-stables for racking up the horses, and for sheep, which are very fond of it. In Scotland, however, the haulm of neither is used for litter, unless it has been spoiled by the weather, or has become sticky by the crop having been allowed to stand too long upon the ground before being cut, and it is there, more prudently, kept for the purposes of feeding.

When straw and haulm are scarce, many substitutes are used as litter, and the quality is but little regarded, because, being seldom employed except in cases of necessity, they do not admit of choice. It is, however, highly injudicious to mix vegetable substances that do not decompose equally, for when the straw in a mixen is fully digested and fit for the field, other articles may perhaps be still in a state of fermentation. Thus, in many places, *heath* serves the same purpose, and makes very good manure; but it is slow in decaying, and requires more than a twelvemonth to go through the process of putrefaction. *Fern*, also, and many of the coarse aquatic plants which yield potash when reduced to cinders, possess very fertilizing qualities, and, when added to the dung-heap in a green state, they become speedily decomposed; but, when dried for litter, that operation is very tedious. It commonly takes more than a year before it is thoroughly concocted; it therefore retards the maturation of the straw, and either the one must be exhausted of its properties, or the other not in a fit state of decomposition when laid upon the land, if both are used in the same dung-heap; but separately, and when properly fermented, fern is as good as straw. The same remark applies to the *leaves of trees;* particularly to those of the oak, which contain an astringent property that renders them extremely difficult of decomposition, and if laid upon the land before they are brought into that state, they are found to be prejudicial to vegetation on light soils. They should not, therefore, be mixed up with straw, but formed into a compost by the addition of scourings of ditches, or any other soil, mixed with quick lime. Great caution should also be observed in making use of the sweepings of the barns, for they often contain the seeds of weeds, even after the dunghill has been reduced to putridity; it is therefore only prudent to use them separately with mould and a small quantity of quick-lime, which should, however, be cautiously applied, as lime has the effect of decomposing vegetable matter so promptly as to materially lessen its bulk.

YARDS AND SHEDS.

We have already said nearly all that appears to us to be necessary on the *management of yards*, and the *construction of sheds* for the preservation of manure, in our remarks upon farm buildings*, though it may be observed that the former are often so full of large holes as to leave them in many parts saturated with water, or their bottoms are either so porous, or else situated on such declivities as to drain off the entire moisture; in either of which cases the loss cannot but be very considerable to the farmer, although he may be ignorant of what he is daily losing, because it does not go out of his pocket in the shape of hard cash. Whenever a yard is circumstanced in either of the ways just mentioned, all the inequalities

* See pp. 95, 169, and 200.

should be levelled, the bottom should be rendered sound and water-tight, and if either any declivity in the yard, or the situation of the buildings, occasions the stock confined in it to give a preference to one part over another, the litter should, in that case, be occasionally removed, in order that it may be equally spread over every part, and the position of the feeding-cribs should be altered; for although our opinion inclines to that form which prefers a gentle slope to the centre of the yard, and the dung should be kept moist, it yet should not be suffered to become drenched with rain. If this be not attended to, the excess of wet will prevent the bottom of the heap from rotting; and if it be not regularly spread to a nearly equal depth, the fermentation will be carried on imperfectly, which will occasion those parts where it may have been too much raised to contract an excess of heat, from which they become what is termed *fire-fanged.* This especially applies to stable-dung, which, if allowed to accumulate in heaps without being properly mixed, acquires a mouldy smell, and loses so considerable a portion of the best part of its substance, that its diminution in value has been estimated by a very experienced agriculturist at not less than from 50 to 75 per cent.*

Acting upon the principle of preserving dung, and rendering it immediately available, it has been recommended to construct cattle-sheds, sufficiently capacious to allow a space rather broader than the platform upon which the beasts lie, but sunk somewhat lower, and to which the dung may be swept up. When thus covered, its decomposition is effected by the aid of its natural humidity, and if left for three or four weeks, its fermentation will be completed. The time at which it is subject to the greatest evaporation of its volatile particles will then be past, and it may be immediately carried upon the land. Its quantity will be certainly less decreased, and its quality better preserved, by being left under the cover of a shed, and there will also be a saving of labour in its removal; but not alone should the neatness and order of stalls be taken into consideration, but also the cost. Theoretic people, when advocating new schemes in husbandry, rarely give themselves the trouble of calculating anything beyond their effects upon crops, without due regard to the expense of their cultivation; and if in this case the additional charges of the erection of the building, together with the repairs, rendered necessary by the steam arising from the dung, were to be reckoned, they would probably be found to exceed the value of the proposed advantages of the plan. While the opinions of practical men on this and other modes of management are so unsettled and discordant, those cannot be deemed imprudent who adopt that side of the question which is the most consistent with economy. We will, however, admit that it would be an improvement if reservoirs for the drainage of yards were so constructed that their contents might be pumped up, and sprinkled over horse-litter, whenever its too great dryness occasions any danger of its becoming fire-fanged; for, whether in the yard, or carried out to the dungheap, it should never be allowed to become so dry as to lose the power of fermentation, and if there should be no portion of it sufficiently moist to allow of the dry part being mixed up with it, so as to prevent that risk, it should be sprinkled regularly when shook up. A watering-pot with a large rose will be found to answer the purpose †.

There can, indeed, be nothing more appropriate to the subject than the observation of Sir Humphry Davy, 'that when dung is to be preserved

* Blaikie on Farm-yard Manure, edit. 1828, p. 5.
† General Report of Scotland, vol. ii. p. 523.

for any time, the *site of the dunghill* is of great importance. In order to have it defended from the sun, it should be laid under a shed, or on the north side of a wall. To make a complete dunghill repository, the floor should be paved with flat stones, a little inclination being made from each side towards the centre: in the centre there should be drains connected with a small well, furnished with a pump, by which any fluid matter may be collected for the use of the land; for it too often happens that the drainings of the dunghill are entirely wasted *.' A sheltered spot of ground ought always to be chosen for the site; and although some after-trouble may be saved by depositing it, in the first instance, in the field to which it is to be applied, it is yet, in most cases, found more convenient to place it in some secluded situation near the homestead. 'There it is always under the farmer's eye, and a greater quantity can be moved in a shorter time than when its position is more distant. Besides, in wet weather the roads are not only cut up by driving to a distance, but the field on which it is made may be poached and considerably injured †.'

These are conveniences, however, that the great bulk of farmers cannot always command; and it often happens that it is necessary to employ the men and cattle in carting the manure to distant parts of the farm some time before it can be spread upon the land. Besides which, it must be admitted to be of much importance, when the turnips are sown, to have the manure ready in the field, as it is then covered in with the least exposure to a burning sun, and the moisture is preserved for the benefit of the crop. In the East Riding of Yorkshire, under 'Farming at Scoresby,' Mr. Howard observes ‡, 'As soon as the farm-yard is emptied, a quantity of light soil, or road-scrapings, is brought into it; all irregularities of surface are then levelled, and the yard is formed into the shape of a very shallow saucer, being the deepest in the centre. This is immediately covered with litter, and made the general receptacle for potato-tops and waste of every kind that is readily convertible into manure. The manure from the doors of the cattle-houses around it is also occasionally thrown into the middle of the yard, that all may be duly mixed. When carted out it is placed on a layer of earth, and banked up in a compact form, to exclude, as much as possible, both sun and air, and then covered lightly over with another layer of earth on the top. By this means none of its virtues are lost, and the top and bottom soil will mix with, and nearly equal in value, the rest of the heap.' This, indeed, is the common practice of all intelligent farmers, and it is evident that, by constantly putting a coat of light soil into the farm-yard when emptied, a considerable addition will be made to the annual stock of manure, as a great part of this will have become saturated with the urine, and will be shovelled up with it whenever it is emptied.

Should there be no perfect and permanent site formed for a complete dung-hill repository, accompanied by a well and pump, as above recommended, yet the space intended for the reception of any common dung-heap should be slightly hollowed out, leaving one side rather deeper than the other, and cutting a narrow drain through that side, from which any superfluous moisture may be carried off to a yet lower excavation, where it may be received upon a bed of loose mould, or among articles of slow decay, as cabbage-stalks, the tough haulm of over-ripe beans, or any similar substances. It should also be surrounded with a mound dug out from the hol-

* Elements of Agricultural Chemistry, lect. vi.

† Brown, of Markle, on Agriculture, vol. i. p. 372.

‡ Report of Select Farms, No. 5, p. 27. See also Middleton's Survey of Middlesex, second edition, p. 377.

lowed place, to prevent water from running into it, and, if that be prevented, no danger need be apprehended from any excess of moisture, except in times of very heavy rain, which, in such seasons, can also be much guarded against by sloping the sides. Were roofs constructed over dung hills, to protect them from the rays of the sun, as well as from the rain, there can be no doubt that, if roughly put up, at little cost, they would prove advantageous; but the benefit should be always closely estimated, in order that it may not exceed the charge: perhaps a contrivance of the kind might be made with spare branches of trees, and worn-out hurdles, supported by posts formed out of any otherwise useless timber.

PRESERVATION OF DUNG.

Practice differs in the modes adopted respecting the *care of farm-yard dung*. Most farmers allow it to accumulate for a long time in the yard, adding fresh straw regularly to the heap, from an impression that the bottom, if unremoved, will become the richest part, and that its accumulation imparts a certain degree of warmth to the cattle; while some recommend 'that it should be cleaned out once a month at least, not only to sweeten the yard, and thereby to increase the health and vigour of the animals, but in order that its contents may be properly mixed in some other place, to induce and bring on a regular fermentation *.' Now, on this it may be observed, that the fears which are entertained by some persons of the vapour arising from dung which is contained in the open air of the yards becoming prejudicial to the health of the cattle are proved by experience to be completely visionary. No really bad odour prevails there; for, although it may be offensive to delicate nostrils, the air is always respirable, and when not confined in close stalls, by which the circulation is prevented, no ill effects are ever known to arise from it. But when the cattle are either fed upon turnips or other green food, the quantity of urine which they discharge drenches such a quantity of straw, that the beasts cannot be easily kept dry; or if they be crowded in badly-arranged yards, and immersed in the filth proceeding from a scanty covering of straw, and the want of proper drains to carry off the superfluous moisture, they may then indeed be exposed to injury from the wet, and the dung should be removed, though in almost any case 'once a month' would be found too often. In many instances the yards are never cleared until the cattle are turned out after the close of the winter; and, unless in a very plentiful season for straw, it is seldom done more frequently, after they are shut up, than perhaps once more in the early part of the spring: except they be soiled during the summer, in which case it becomes frequently necessary. When proper care has been used to prevent an excess of rain-water, the manure thus obtained from the bottom layer will doubtless be found of superior quality; but the whole heap ought to be well mixed, in order to render it of equal value.

An eminent agricultural author, whom we have already quoted, complains that he has not, in any one instance, been able to find anything like system in the mechanical arrangement of the component parts of farm-yard mixens, which he generally found put together as they arise, according to circumstances, and without any regard to rule. Hence it follows that their real value as manure can never be distinctly known to the farmer, nor can he apply that proportion which a more accurate knowledge of the contents would enable him to apportion to different kinds of grain, or to the particular soils and seasons in which they can be most advantageously

* Malcolm's Modern Husbandry and Survey of Surrey, &c. vol. ii. p. 8.

applied. A heap, for instance, composed entirely of dung from stables where horses have been plentifully fed with corn, must be far superior to one produced by cattle in the straw-yard; yet so little is this very material point adverted to, that nothing is more common than to hear of 'so many loads per acre' being laid upon the land, without regard to the ingredients which it contains, though nothing is more certain than that its power over the crops will be in exact proportion to the qualities of the materials of which it is composed *.

This writer advocates the separation of the various species of manure, in order that the properties of each may be distinctly ascertained; yet another author, of equal experience, says, in treating of Norfolk, 'that the principal error in the common method of manufacturing farm-yard dung originates in the prevailing custom of keeping the dung arising from different descriptions of animals in separate heaps or departments, and applying the same to the land without intermixture, and consequently in an improper state.' He then alludes to the difference arising in the manure from the modes of keeping fatting and store cattle in yards by themselves, 'while horse-dung is also usually thrown out at the stable-doors, and there accumulates in large heaps, which very soon ferment and heat to excess;' he therefore recommends that litter to be spread over the straw-yard, and the whole of the dung from the different yards and the hogstyes to be mixed together †.

On these opposite opinions we have to remark, that, when either the soil or the intended crop is essentially different, it may be very desirable that the manure to be employed should possess distinct properties, and therefore, in such cases, a portion of it should be separately kept, as well as differently prepared. Thus warm and cold soils require manures of a contrary nature; an advanced stage of their fermentation is in some cases less favourable to vegetation than in others; and, in the instance of potatoes, it is well known that stable-dung is employed with more effect alone than when mixed. It may, therefore, be advisable that horse-litter in particular should be separately kept in the yards, not merely for the purpose just mentioned, but that, as being of a hotter nature than any common dung, it may be mixed with that of other cattle in such proportions as may be thought best adapted to the purposes for which the compost may be required. If no better arrangement can be made, the litter should be placed within some dry ditch, which will answer the purpose of a more regularly constructed pit, where its moisture may be maintained without too greatly heating it, and without exposing it to the evaporating action of the air. Thus, if care be at the same time taken to prevent it from becoming dry, the fermentation will be checked; and should it be thought expedient to still further retard that operation, it may be effected by a mixture of hog's-dung, which, though rich, yet being of a colder nature, is less fermentable. By this union the dung becomes decomposed into a soft and pulpy mass, which forms a very powerful manure, and, by a little judicious management, can be either promptly got ready or be kept back at pleasure.

Under other circumstances, however, and especially on small farms, where the quantity of materials may not be sufficient to allow of their being separated without incurring the risk of loss by the excess of evaporation, or by the want of due fermentation, it is found more generally expedient to spread together all the different sorts of the dung of the larger animals in different layers, so that each may be regularly mixed and partake

* Malcolm's Modern Husbandry and Survey of Surrey, &c., vol. ii. p. 3.

† Blaikie on Farm-yard Dung, edit. 1828, pp. 3, 5, 6. See also the Nottinghamshire Report, p. 168.

equally of the common properties of all, by which means the faults of one species are corrected by another; the too rapid fermentation of the dung of horses is checked, while that of hogs and horned cattle is accelerated, and thus the whole mass acquires the enriching properties of the most fertilizing compost.

PREPARATION OF MANURE.

Dung, thus indiscriminately thrown together, being composed of every species, whether from horses, pigs, or black cattle, bedded with a litter of straw and hauhn, to which every vegetable substance that can be collected round the house and premises should be added, forms a combination of fermentable matter of various kinds, which, with due care, may soon be brought into a fit state of preparation. Instead, however, of laying it in a regular manner, it is too often suffered to remain in different heaps, in whatever part of the yard it may have been carried from the barn and stables, in which condition it is left during the winter; and being thus imperfectly fermented, its value is, in all such instances, very materially injured: whereas, if spread as equally as possible over the entire yard, the different materials becoming thus well mixed together, their different properties are blended, and a compact mass of manure is produced of equal quality.

It should, however, be observed, that there is in every farm-yard a proportion of hot and pungent dung, produced by poultry and pigeons, which should be separately kept for top-dressings, for which purpose it may be found very useful: if scattered over the common heap, it will, however, have the effect of increasing the fermentation, and hastening its decomposition. That of swine, also, when thus mixed, has the same effect; and it was proved, after repeated trials, when the temperature of the air was 40° of Fahrenheit's thermometer, that of

Common farm-yard dung was about .	70°
A compost of lime, dung, and earth .	55°
And a portion of swine and fowl's dung	85°*

Care should also be taken that, if any other substances than those commonly employed be added to the heap, they be of such a nature as will render them equally susceptible of decomposition; if not, a small quantity of quick-lime will have that effect; but it should be applied separately. Lime should also be added to all weeds which have ripened their seeds, as well as to the roots of docks and other noxious plants, which long retain the power of vegetation, and spring up when laid upon the land, unless they are destroyed. The better way, indeed, is to place them in a spot away from the yard, and to mix them into a compost, as will be hereafter mentioned.

On what has been said respecting the *removal of dung and litter from the farm-yard*, it should also be remarked, that their being retained during a long time in the yard is inconsistent with the comfort of the cattle and the due preparation of the manure; for if straw be added in sufficient quantity to keep the former dry, although the lower layers of the manure may be in a good state, yet those at the top cannot. Straw, flung out to the yards in considerable portions, becomes, after being compressed by the trampling of cattle, rather like a well-packed stack than a mass of dung in a good preparatory state. Except where a considerable stock is soiled, the small quantity of urine and dung made by the animals is barely sufficient to cause

* Farmer's Magazine, vol. xiv. p. 160.

a slight fermentation in the heap, which brings on fire-fanging, after which its original powers can rarely be restored. To prevent that injury, no measure can be so successfully used as a frequent removal of this unmade dung, especially if the weather be wet at the time; for there is in such cases so much straw that has not passed through the entrails of the cattle, as renders it almost impossible to do injury by an excess of moisture*: if, therefore, its removal be deferred to any distant period, a proportionately greater length of time must necessarily be devoted to its turning and being got in order for the field. Unless over-year muck be used, if the manure be required for turnips, it will be found necessary to lead it from the farm-yard as soon after Christmas as the weather and the state of the roads will admit of it; or, if wanted for beans, that should be done much earlier. No period is more advantageous for this work than a frost; and if much manure is wanted early, it may be led from the yard a second time in the month of February. It should not be forgotten that the lighter it is laid upon the heap, the more rapid will be the decomposition; and that it may be retarded by compactness of form, and pressure on the top with a heavy coat of soil. This, however, must depend upon the quantity of litter and of cattle, of the extent of the yards, the state of the weather, the condition of the manure, and the intention to which it is to be applied,—all varying according to circumstances, for which no precise rule can be laid down, and which must therefore be left to the judgment of the farmer. Yard dung, made in winter, if trodden by cattle, will not be found to ferment much. It ought, if possible, to be kept neither too wet nor too dry; if in the former state, it will injure the stock, without forwarding its own decomposition; and if in the latter, it will become mouldy, or fire-fanged, and lose its most valuable qualities: in order to prepare it in the best manner, it should therefore be preserved in a mean between the two extremes†.

Throughout most counties the general plan is, after foddering is over, to carry out the dung from the farm-yard, and to place it in large heaps, in order to occasion a due fermentation, and to render it quite rotten before it is laid upon the land. There are, however, many circumstances which render practice and opinion at variance on this point, in consequence of which a great portion of the manure is carted directly to the fields, and applied to the intended crop, either fresh, or perhaps after being once turned over. The apprehension that dung loses much of its virtue by evaporation is not entirely unknown or unattended to; but people think differently on the subject. Several farmers maintain that ploughing in the manure as soon as it is laid upon the land is unnecessary, if not injurious; because they say that it absorbs the nightly dews and other substances from the atmosphere, by which its quality is improved; that the rain will wash in the salts, while the sun only exhales the water; that, when spread upon the surface, the soil also thus becomes gradually impregnated with its juices; and that clay land in particular is rendered mellow and free to plough. Thus with many it is the practice to carry out yard-dung in its long and hot state, and to suffer it to lie both upon arable and grass land for perhaps a month or six weeks after being spread, before it is ploughed in, though it is acknowledged to encourage the growth of twitch and other weeds ‡. Others cover it, or, as it is termed in Norfolk, 'scale it in,' with a slight

* Brown, of Markle, on Agriculture, vol. i. p. 375.
† East Lothian Report, p. 158.
‡ Buckinghamshire Report, p. 273; Norfolk do., p. 174.

coat of mould. On the other hand, although the process of fermentation by disengaging a quantity of carbonic acid and ammonia, causes an evaporation, by which the bulk of the manure is much diminished, yet its power is thought to be thus increased. This apparent diminution in bulk has indeed been too much insisted on by the opponents of rotten dung, as proof of its decrease in value; for, although the size of the heap thus evidently becomes smaller, yet its cubical contents are, by its condensation, increased in weight*. After about six weeks it assumes a saponaceous, greasy appearance, in which soft and sappy state, when neither fresh nor too rotten, but in the medium between those states, it is generally applied to the land by the best farmers. When very rotten, its effect is more immediate and powerful; but when only moderately rotted, its effect, though more gradual, is found to be more durable.

On this *subject of evaporation*, which has justly engaged so much of the attention of scientific agriculturists, we, however, add the following extracts from the work of Von Thaër, whose practical knowledge cannot be too highly appreciated. He says, that not only does theory teach us, but during his own experience he has had frequent occasion to observe, that it is hurtful to remove farm-yard manure while it is in a high degree of fermentation; for, according to all appearance, an essential portion of the most active substances of which it is composed are evaporated when exposed to the air while that process is going on. But, before the fermentation has arrived at its height, or after it has passed, the dung does not seem to lose anything by exposure to the air; or, at least, nothing but what it regains by some other means.

That an evident advantage attends the spreading of fresh strawy dung upon the surface of the soil during the winter, and leaving it there in that state until the spring ploughing (it being, at the same time, well understood that no declivity of the land allows of its being washed away by the rain)—for this method of covering the ground occasions it to absorb the juices of the dung, and thus renders it not only friable to work, but extremely productive: so much so, that the straw has been afterwards raked off the land at the close of the season, and yet the soil has appeared as much improved, as that in which the whole of the litter had been buried—an effect which is also apparent in meadow ground which has been similarly treated. Not alone has this occurred in many such instances; but in others, in which both long and short dung have been spread upon land already sown with tares and peas, and though left there during vegetation, have produced the most beneficial effect upon the crops, especially when sown late, and applied to ordinary land of a light and warm nature; but what appears

* The weights of putrescent manures will depend much upon the progress of their decomposition at the time, as well as the proportion of moisture which, from accident or particular treatment, they may contain. From an experiment on the subject, recorded in the Farmer's Magazine, we learn that the comparative weight of the following substances was as follows:—

	cwt.	qrs.	lbs.
One cubical yard of garden-mould	19	3	25
Ditto of water	15	0	7
Ditto of a compost of earth, weeds, lime, and dung, that had lain nine months, and been turned over . . .	14	0	5
Ditto of new dung	9	3	18
Ditto of leaves and sea-weeds	9	0	7

Thus, a cubic yard of water is to that of new dung nearly as 3 to 2.—vol. xiv. p. 162. Von Thaër calculates the weight of a cubic foot of any strawy farm-yard manure at only about 46 lbs.; while one which has been partly decomposed will weigh from 56 to upwards of 60 lbs. without being compressed.—*Principes Raisonnés d'Agriculture*, tom. ii. p. 328.

more extraordinary, and difficult to explain—the land which has been thus managed has evinced a decided superiority in the subsequent crops over ground on which even a larger quantity of dung had been regularly ploughed in.

That, as one proof of this, in the spring of 1808, rape was sown along with clover upon a poor soil, and was afterwards covered with fresh dung: in the autumn of 1809, the clover-ley was broken up, and rye was sown; the crop of which in the following year was distinguished by its superiority over that of an adjoining field which had been dunged upon a summer fallow. Indeed, after a number of comparative experiments, made by himself as well as by other farmers, it appeared to him beyond all question—however incredible it may seem to those who have not also tried its effects—that dung which has already passed the extreme point of fermentation, not only loses nothing by being exposed upon the land, even during the summer, but even gains. The evaporation may, indeed, be not so great as it is generally supposed; for although it is true, that when the dung is carted out and spread, it then affects the air with a strong musky smell, yet there is no mode of avoiding that; and even if there were, the vapour which is thus diffused is so tenuous, light, and expansive, that doubts may be entertained whether the quantity of sap which is thus evaporated can be very considerable, as, after a short period, the dung does not exhale any odour. According to the experience of M. Thaër, it does not lose in weight; and he remarks, that, if laid during a few weeks upon a summer fallow, a number of young plants of a very vivid green will be seen to spring up, even upon spots which have not come into contact with the dung; which proves that its fertilizing properties were spread around, even before it had been buried in the soil *.

We have thus entered at large into this discussion, because we consider it important to throw every light upon the subject of which it may be susceptible; and it besides contains some strong reasons for the application of long dung.

There are, however, many farmers who persist in the use of *over-year muck*, or that which has been kept perhaps a twelvemonth, or more, until it is completely reduced to a pulp, in which state it is very commonly applied to turnips. It thus loses perhaps half its bulk; but it is considered peculiarly favourable, and even necessary to the growth of that crop, as its power upon vegetation advances it so rapidly as to put it promptly out of the reach of the fly †. When, however, the process is carried too far, and

* Principes Raisonnés d'Agriculture, tom. ii. p. 315, § 600. It is difficult to ascertain the precise degree of evaporation arising from fresh dung; but, by an experiment made by the Rev. St. John Priest, Secretary to the Norfolk Agricultural Society, in the presence of Mr. Curwen, of Workington, it was found that steam was evaporated by a piece of moist ground held under a large glass during a quarter of an hour, in the month of October, at the rate of about 1½ cwt. per acre. Survey of Buckinghamshire, p. 274.

This, indeed, appears a large amount within that space of time; but, had the experiment been longer continued, it would have been much diminished, and would, no doubt, in a short time, have entirely ceased.

† Mr. Young, indeed, says, 'that long stable-muck has been carried out for turnips in March, without any stirring, and that the crops were as good as from short muck, though the growth of the plants was not so quick; but then 15 loads of the former were laid on instead of 12 of the latter. Long and short dung have also been mixed together, and laid upon strong land, with good effect. It was carted from the yard late in the spring, forming heaps which in three weeks were turned over, and, within a fortnight more, were laid upon turnips; but the practice is not common, nor very likely to be generally followed.—Norfolk Report, chap. xi. sect. iii.; Essex do., pp. 229, 240.

the manure has been frequently turned,—until, as said by some farmers, '*black butter* becomes *black snuff*:' it has then, indeed, been found so completely deprived of its nutritive sap as to produce no effect whatever upon the land. On the whole, there is reason to believe 'that there is, in the management of dung, as in all things else, a certain point which constitutes the maximum of profit, beyond which there is nothing but loss*.'

The *management of farm-yard manure*, upon light and heavy soils, should differ according to the use intended to be made of it; for it is generally employed in different seasons and applied to different crops. For light land, on which the most common crop in the commencement of a rotation is usually turnips, it requires to be highly fermented; because, if not incorporated with the ground in that soft and sappy state in which good spit-dung ought to be, the plants will not receive such immediate nourishment as will serve to push them into rough leaf before the attacks of the fly. But for clays and other strong soils generally, whether the manure be applied to a fallow under preparation for an autumn sowing of wheat, or in the early part of the spring for beans, as it has a longer time to decompose in the soil, a less degree of putrefaction is necessary than for turnips. Potatoes, also, though grown on light land, may be raised by the use of fresh unfermented manure, because they do not require the same nutriment as turnips during their early growth, and because they are also supposed to be assisted by the action of long dung in opening the soil †.

When, therefore, a farmer looks chiefly to a prompt return through immediate benefit to the next crop, the manure should be thoroughly rotted to the condition of spit dung; 'but if his views extend to subsequent crops, or if the soil be of a nature to receive benefit by the fermentation and heat produced by the application of long dung,' then it has been affirmed 'that preference should be given to that in a fresh state, provided it be immediately ploughed in and totally covered ‡.' This, however, although the opinion of the author whom we have just quoted, as well as that of several eminent practical men, should yet be received with a certain degree of caution; for, besides the objections already stated to manure of this description, there is such difficulty in ploughing in the straw, that much of it is necessarily left upon the surface of the soil, where its virtues are in a great measure lost; or, if buried deep in cold and retentive clays, it becomes locked up in the land, and its fermentation is prevented. In order to bring it into such a state of decomposition as we have already stated, the information which we have collected on the subject may be thus condensed.

On most farms the *yards are commonly cleared* towards the middle, or the latter end, of April; though in some this does not prevent the work from going partially forward during the winter, and thus preparing some of the manure in succession: at whatever period it may however be done, the following is the most advisable method of proceeding.

The most usual mode is to carry out the dung from the yards, either to some waste spot adjacent to the homestead, or into the field to which it is meant to be applied, and there to leave it exposed to the weather, without any other preparation than turning it over, until it be completely rotted, or else until such time as it may be thought requisite to lay it upon the land. The better plan, however, is to lay a bottom for the dungstead, consisting of a bed formed of clay or sand, ditch and road scrapings, marl,

* Surveys of Bedfordshire, p. 506—508; East Lothian, p. 159.

† General Report of Scotland.

‡ A Treatise on the Connexion between Agriculture and Chemistry, by the Earl of Dundonald, p. 98.

or any similar substance, which must be well mixed and pulverized, and then spread to the extent in length and breadth which it is supposed the heap will cover, and from a foot to 18 inches in depth, but raised at the sides and sloped to the centre, so as to absorb the liquor which oozes from the dung during the heating and putrefaction which always take place while it lies in the heap. The yard dung is then carted out, and shot upon the bottom; one end of which is at first left lower than the other, in order to render the ascent easy to the cattle—a practice, however, as we shall afterwards see, which is not always to be commended. It is then thrown slantingly up until the heap rises to four or five feet above the foundation; after which, careful farmers raise a coating of the same materials as the bottom, a couple of feet in thickness, which is spread round the heap to its full height: or, when the mixen is raised upon the field in which it is intended to be applied, the soil may be ploughed around the heap, and plastered or faced up against the sides by the back of a spade. The dung is then allowed to duly ferment, which may be seen by its sinking, and easily ascertained by thrusting a few sticks, of the common size of broom-handles, into different parts of the heap, as well as by its steaming and offensive smell, which, however, subsides when it is thoroughly decomposed. Dark-coloured putrid water is also drained from the heap, and there can be little doubt that this discharge of vapour and fluid will, if permitted, occasion the loss of some portion of the virtues of the manure; in order to guard against which, a thin coat, of the same kind as the sides, and made as fine as possible, is laid regularly and lightly over it, so that its weight may press equally and not heavily—for, if left in lumps, their cumbrous weight would force the dung into holes, and prevent its regular fermentation.

By this covering of the dung with a due proportion of earth, or of other coating, that loss is however in a great measure prevented; and the bringing of the heap into a state of preparation either sooner or later, as circumstances may require its application to the land, can be effected by the denseness and compression of the covering. The operation therefore requires considerable delicacy; for, if dung, already in an unfermented state, be so closely pressed as to effectually exclude the air, it will be found, perhaps at the distance of several months, in a state very little different from that in which it was put up; or, when it is thought to be in a perfect state of preparation, it will, upon examination, be discovered to be only decayed, and, instead of abounding in rich mucilaginous substance, to consist almost entirely of mere vegetable earth.

This also leads us to remark on the common practice of *driving carts, with their loads, upon the dunghills;* the consequence of which is that, as nearly the same road is followed by each cart in crossing them, it is not possible to draw load after load upon such a heap without compressing those parts where the horses tread, and thus, instead of the dung undergoing a regular fermentation, which every part necessarily would if it had been thrown loosely on the heap, and of one uniform thickness, it is, in some spots, consolidated into a mass which, in most instances, greatly retards, and in some entirely prevents, the process; 'becomes mouldy, from want of air, caloric, and moisture,—acquires a musty, turbid smell,—generates fungi,—and is, in that state, injurious to vegetation *.' The system has indeed been defended by some very able men, one of whom insists 'that the dung should be drawn out of the yards, and placed upon the bottoms, though not in the

* Malcolm's Compendium of the Modern Husbandry of Surrey, Kent, and Sussex, vol. ii. p. 5

usual way of throwing it up loosely, to cause fermentation, but, on the contrary, by drawing the carts, with their loads, *upon the heaps*, for the purpose of compressing the dung, and thereby *preventing fermentation** ;' and another conceives that 'a positive benefit will be gained by this slight compression †.'

This difference of opinion may however have arisen from attention not having been paid to the different qualities of the dung, as well as to the use intended to be made of it. When the materials removed from the yard consist chiefly of litter in a fresh or rough state, not sufficiently saturated with the urine of cattle, or when the manure is not intended to be immediately applied to the land, no serious damage can ensue from driving the carts—which are usually drawn by one horse—across the heap, when the dung has risen to some height upon the foundation; but if that operation be performed before some considerable portion of the dung be laid on, the inevitable consequence will be that the bottom, which consists either of earth or of other matter devoid of elasticity, will thus be kneaded into solid and unequal lumps, which will occasion the effect complained of. Care should therefore be taken to make the heap so narrow, that, by driving on each side of it, the carts may be backed, and the dung shot upon the pile, which may then be levelled with grapes, or forks, and laid compactly together. Much labour of the teams will thus be saved: if the object be to prevent fermentation, the dung may be regularly and closely trodden down by the men employed in spreading and levelling it; and the quantity of earth to be laid over it may be regulated accordingly. If, on the other hand, the manure be intended for immediate use—then the dung should be thrown lightly together without treading, and the quantity of earth on the sides and top should be reduced; or, if the dung be of a hot nature, from which too sudden or violent fermentation may be apprehended, a portion of the earth may be intimately blended with it, and it will thus be soon brought into a fit state for application.

It must not, however, escape observation, that store cattle are often kept in straw-yards apart from other stock; or else that, when the same yard is used, the stable-litter of horses is thrown separately out, and thus produces two very distinct species of dung. Attention should therefore be paid, in clearing the yards, to take a few cart-loads from each kind alternately, so that the whole may be, as nearly as possible, equally mixed, and heat alike. It will thus also be seen if any portion of the dung is too dry, in which case it should be distributed among that which is wet; and if there be any general deficiency of moisture, or if the external parts of the heap become dry during the process of fermentation, they should be thoroughly wetted. The heaps, too, should be of moderate size, by which means they can be turned and got ready at different periods, as occasion may require ‡.

* Blaikie on the Management of Farm-yard Manure, edit. 1828, p. 13. See also Sinclair's Code of Agriculture, 3rd edit., p. 218.

† Brown, of Markle, treatise on Agriculture and Rural Affairs, vol. i. p. 375.

‡ On this subject, Mr. Coke is said to have lately expressed himself, at a public dinner in Norfolk, to the following effect:—'Having made a platform of marl, I placed the inferior muck upon it; the manure of the fat cattle formed the third coating, and upon that the horse-dung as the fourth, and in about equal quantities. I then ploughed round it, threw up the earth, and made a kind of coating over the whole to keep in the gas. Just before sowing, the heap was turned over; and thus, when the muck was in a state of fermentation, it went into the drill. Let farmers follow this plan, and give plenty of seed, and they will not find their crops of turnips to fail; the warmth of the manure would force the turnips out of the way of the fly in less than eight-and-forty hours.' In Dr. Rigby's account of Holkham, it is also stated that, by preparing ma-

These *pies*—as they are provincially termed when thus crusted over—if ready by the 1st of May, may be reasonably expected to be in a fit condition to be laid on the summer fallows by the latter end of July, though the time required for their preparation must be governed by the strength of the dung, the weather, and the exact period of its intended application. Those formed during the summer months, unless the dung be produced by horses and cattle kept in the yards by soiling on green food, can seldom be collected and got ready for use within the same season; but when intended for turnips, the manure should be carried out and lightly raised about six weeks or two months before it is wanted, within ten days or a fortnight of which time it should be very carefully turned.

The *operation of turning* is also one that requires circumspection. This is often neglected until the heat of the mixen is quite spent, its fermentation passed, and it is become entirely rotten. To which glaring error is to be added the carelessness employed in that labour by servants, who, in turning it over, usually begin at one end, and throwing layer upon layer as they cut them through, place them again in the same order in which they found them, with this only difference, that the part which was at the top now becomes the bottom. Thus it has been justly observed by Mr. Malcolm, that 'the benefit which might have accrued to each ingredient by their proper admixture is infallibly lost, because the dung has been prevented from infusing any of its saline particles into the mould, and when laid upon the land, instead of being a body of invaluable manure, they are little better, as such, than as if each ingredient had been immediately drawn from the beds out of which they were originally taken *.' All this may, however, be easily avoided by cautiously observing the probable state of the fermentation of each heap, and by turning it completely over either when it requires lightening or pressure; by narrowly watching the process, so that every part may be thoroughly shaken up, the clods and lumps in the bottom, top, and sides well broken, the adhesive parts of the dung separated, and moisture added if necessary. When this process has been attentively performed, it has been recommended by Mr. Blaikie 'to immediately plough several furrows of the natural soil all around the heaps, and with the loose earth ploughed up again coat the heaps all over: the pies will then take a gentle fermentation; the earth intermixed with and covering the dung will absorb the juices and gases of the dung, and the compost will come out in a fine state of preparation for using on turnip land †.' From manure of this description, in which all the materials are intimately blended, soaked with putrid water, and decomposed to a degree of mellow consistence, different sorts, to suit different soils and crops, cannot indeed be taken; but perhaps, with the single exception of potatoes, this one sort of farm-dung, managed as above, may be successfully applied to every crop, and to every kind of soil.

LONG DUNG.

Such is the most common practice with the generality of farmers regarding *fermented dung;* but there is another system of management advocated by some eminent chemists, who recommend that it should be used in a *fresh state*—that is to say, after it has begun to ferment; for it is well known that dry vegetable and animal matter cannot be properly made to

nure in this manner, Mr. Coke saves no less than 500*l.* per annum in the purchase of rape-cake as top-dressings.—3rd edit., p. 56.

* Compendium of Modern Husbandry, vol. ii. p. 6.

† On Farm-yard Manure, edit. 1828, p. 15.

serve as manure until that process has commenced. On the effects of the fermentation of farm-yard manure, and the length to which the operation should be carried before it be applied to the soil, there exists indeed an extraordinary difference of opinion among the written authorities on the subject, and the practice of many eminent farmers is equally at variance. It was long ago asserted, that 'there was good reason to believe, from many facts, that putrefaction was no way necessary to the nutritive power of animal and vegetable matter, but in so far as it diminishes their cohesion, or destroys their texture, and renders them fitter for absorption; and as there is considerable waste in gases and ammoniacal and nitrous salt by their putrefaction, it is of importance not to allow the putrefaction to take place at all where it is not required to break the texture *.' In support of that theory, various other authorities were quoted by the late Secretary to the Board of Agriculture, in the treatise on manures which gained him the Bedfordian medal of the Bath and West of England Agricultural Society †. Many who previously doubted it have been since persuaded of its superiority by much practical as well as theoretical evidence then brought forward; to which there has been since added the powerful arguments of Sir Humphry Davy, who thus expresses himself:—

'Whoever will refer to the simplest principles of chemistry cannot entertain a doubt on the subject. As soon as dung begins to decompose, it throws off its volatile parts, which are the most valuable and most efficient. Dung which has fermented, so as to become a mere soft cohesive mass, has generally lost from one-third to one-half of its most useful constituent elements; and that it may exert its full action upon the plant, and lose none of its nutritive powers, it should evidently be applied much sooner, and *long before decomposition has arrived at its ultimate results.*

'A slight incipient fermentation is undoubtedly of use in the dunghill, for by means of it a disposition is brought on in the woody fibre to decay and dissolve when it is carried to the land, or ploughed into the soil, and woody fibre is always in great excess in the refuse of the farm. Too great a degree of fermentation is, however, very prejudicial to the composite manure in the dunghill; it is better that there should be no fermentation at all before the manure is used than that it should be carried too far; for the excess of fermentation tends to the destruction and dissipation of the most useful of its parts, and the ultimate results of this process are like those of combustion ‡.'

The sentiments of this celebrated chemist are certainly entitled to great weight; but though we admit that the fermentation of farm-yard manure may be rendered injurious, both through the waste which occurs in bulk §, as well as by the loss of some portion of its nutritive properties, if that process be carried to excess, yet we are inclined to doubt the correctness of that position which says 'that it should be applied long before decomposition has arrived at its ultimate results.' We think, also, that some distinction should be drawn between the different kinds and qualities of dung, as well as of the crops to which it is to be applied, and of the season in which it is to be used, before any such unexceptionable rule should be adopted for its preparation. Thus, to recommend the application of fresh manure for a crop of turnips, in like manner as for another of potatoes,—for heavy clay equally as for a light sandy loam, or to draw

* Dr. Pearson's Notes on Cullen, quoted by Arthur Young in his treatise on manures, chap. vii.

† See the Papers of the Society, vol. x. art. x.

‡ Elements of Agricultural Chemistry, lect. vi

§ See, however, the note in p. 239.

no distinction between the time in which it is to be laid upon the land,—rather affords evidence of theoretic generalization than of sound conclusions drawn from a multiplicity of well-supported experiments, and established by practical effect*.

There are perhaps few agricultural subjects on which theory and practice are so much at variance as in the management and application of putrescent manure. There is hardly a farmer who will not admit that a crop of turnips may be altogether risked if short muck be not employed; and though some of them are often under the necessity of applying a portion of long dung perhaps to the same field on which the former has been laid, yet the very drill on which the two kinds meet may in general be distinctly pointed out, while potatoes, on the contrary, are almost invariably planted on fresh farm-yard manure: though neither of these instances prove either that fresh dung gains any fertilizing power by fermentation, or that short muck loses it; for these facts apply only to the mechanical action of the manures, and to the natural economy of the plants. It is also generally admitted that long dung is more suitable to clay lands than to light soils, which are rendered too porous by its application; and, in like manner, fresh manure is objected to for all spring crops, because it is found to keep the land in too open a state in dry weather, and liable to be burnt up in the summer.

Sir Humphry, however, adds—'that the *dry straw* of wheat, oats, barley, beans and peas, and spoiled hay, or any other similar kind of dry vegetable matter, is, in all cases, useful manure. In general, such substances are made to ferment before they are employed, though it may be doubted whether the practice should be indiscriminately adopted.'

On which it may be observed that although in another passage he admits 'that a great objection against slightly fermenting dung is, that weeds spring up more luxuriantly where it is applied,'—which forms in itself a strong *impediment*; yet that is not the only fault to which it is exposed—for it also occasions foul husbandry. It is scarcely possible in any soil to plough down effectually a large quantity of rank strawy manure; for even the stubbles, when cut high, are found difficult to bury, and more especially on light land this fresh stable-dung slides along the ground before the breast of the plough, and thus clogs the furrow. The harrows also drag up considerable quantities, which not alone impede their action, but a large portion of the manure is thus scattered over the surface of the ground, and uselessly left there to perish; and litter that had been ploughed down fresh has, in numerous instances, been turned up in the following spring without any apparent change. Objections such as these are not easily obviated, but even were they surmounted, the value of the dung in that state of preparation still remains to be considered.

Of the mysteries of nature in her supply of food to plants we have no certain information, and it is even probable that they will ever elude discovery. Some experiments which were made by Sir Humphry Davy, however, favoured the opinion 'that *soluble matters pass unaltered into the roots of plants;*' in support of which he says—'that the great object in the application of manure should be to make it afford as much soluble matter as possible to the roots of the plants, and that in a slow and gradual manner, so that it may be entirely consumed in forming the sap of

* On this it has been observed, that, in the instance of turnips, Sir Humphry only meant to say, 'that the manure should be applied *long before decomposition* had arrived at its ultimate results:' but this does not weaken the general force of our remark, which refers to the indiscriminate use of long dung.

the organized plant;' in order to attain which effect, he admits '*that it must undergo chemical changes.*' Now, the materials of which the great bulk of farm-yard manure is composed, consist chiefly of straw or other litter, which, being fibrous, can only be rendered soluble by fermentation but chemical theorists assert that this process should be perfected at least, if not commenced, underground; for they insist that, if completed in the dunghill, it would occasion a great loss of nutritive matter; and it must be admitted that several practical men of considerable judgment have become converts to the same notion. Thus, one of the latter body says—'that, although half-rotted manure will sooner disappear in the soil, and that the crop sown along with it may often be better than on fresh dung improperly applied, there may be little doubt; but there can be as little that, during the time the latter is visible, it has afforded the greatest share of nourishment;' and he then asserts, 'that the ravages of fermentation and exhalation are more to be dreaded, and ought to be more guarded against, than any other waste to which a heap of dung is liable*.'

In contradiction to this, however, another writer upon the same subject thus expresses himself:—'The object of applying all kinds of manure is to nourish the seed which is sown in the earth; and we know from observation that its development is much accelerated by the immediate assistance of manure. If manure requires to be in a soluble state before plants derive benefit from it, it is evident the greater state of solution in which the manure is, the more easily will the plant be enabled to derive benefit from it. This point is finely illustrated by the quicker efficacy of liquid than solid manure in nourishing the plant, when both are applied in equal strength. Now, if there is no way of making manure soluble but by fermentation, it is also evident a great degree of fermentation will dissolve all the fibrous portions of putrescent manures the more easily. This point is also well illustrated by a fermented dunghill, the materials of which, if properly commixed, will ferment strongly for a time, and then the fermentation will subside to a low degree, leaving the whole mass in that pulpy, sappy state, than which nothing can give a better idea of a soluble state of a fibrous body. Whether any really nutritive matter is driven off by fermentation before the mass is brought to that pulpy state, may be doubted; for the evaporation from such a dunghill appears to be just the steam of water in a highly elastic state, glimmering like a hot haze in a sunny day, on looking across a ploughed field. But even should some gaseous matter escape during fermentation, this undeniable fact remains untouched—that this fermented, pulpy, sappy mass of manure will go much farther in maintaining the fertility of land than the *same bulk*, or *weight*, of recent farm-yard manure †.'

On the latter point we think there can be no rational doubt; for it is very generally allowed that an equal quantity of short muck, or that which has been merely reduced to the state of spit-dung, is more immediately effectual as manure to the present crop: but the question still remains to be decided—Whether the same amount of substance, if laid upon the land previous to its diminution by the loss of fluid and of gaseous matter, has not a more lasting effect on the improvement of the soil? It can only be determined by long experience upon different soils, seasons, climates, crops, and rotations; and we agree with Mr. Finlayson that, 'in order to make a fair trial, it might not be unworthy of the agriculturist's pains to place, for example, a ton of fresh dung in a favourable

* Finlayson's British Farmer and Ploughman's Guide, 2nd edit., pp. 65, 68.
† Quarterly Journal of Agriculture, No. xix. p. 82.

situation for fermentation; to turn it over once or twice; and when rotted down to the bulk, weight, and consistency thought most expedient, or usually allowed, to put it and a ton of fresh dung of the same sort on equal spaces of very poor land, and weigh the produce of the three following crops; by which means the matter would soon be set at rest, and, with the majority of farmers, a greater uniformity observed in the management of this division of their business *.' We accordingly extract a comparative experiment made by an intelligent practical farmer on three kinds of manure, and on a cultivated soil without manure—half a rood of ground being allowed for each :—as follows :—

Successive Crops and Produce from a single application of the following Quantities, viz.:—

	Fresh stable-dung in a straw state, 3 tons. PER ACRE.	Rotten dung, 8 months old, 2 tons. PER ACRE.	Dry barley-straw, burnt on the ground, 15 cwt. PER ACRE.	No manure. PER ACRE.
1st crop, Turnips,	18cwt. 6st. 6lbs.	16cwt. 1st. 4lbs.	8cwt. 3st. 7lbs.	1st. 8lbs.
2nd crop, Barley,	30 bush. 2 pks.	36 bush. 3 pks.	30 bush. 1 pk.	14 bush. 3 pk.
3rd crop, Clover,	20cwt.	21cwt.	18cwt.	8cwt.
4th crop, Oats,	38 bush.	40 bush.	18 bush.	32 bush.

As to the feed after the clover, it was about equal to the expense of getting in each crop respectively, with a small surplus on the plot manured with rotten dung.

To complete this experiment, there should, however, have been a notice added of the proportion of weight which fresh stable-dung would lose within eight months; for three tons would scarcely, at the expiration of that time, amount to more than half that quantity of completely rotted dung; though when farm-yard manure is reduced one-third in weight, the fermentation may be, in most cases, considered as far enough advanced for the general purposes of agriculture. Supposing the original quantities to have been equal, the above experiment would be, in every part of the rotation, in favour of rotted dung, with the exception of the inferiority of the turnip-crop, which, in this instance, remarkably contradicts the practice of its application; though, without more clear information regarding the soil, the culture, and the weather, no positive conclusion can be drawn from that fact †.

In his remarks upon the *formation of dung-heaps*, Sir Humphry justly observes—'that an immeasurable quantity of substance disposed for conversion into food for plants is suffered to escape in the form of drainings and vapour. During the violent fermentation which is necessary for reducing farm-yard manure to the state in which it is called "*short muck*," not only a large quantity of fluid, but likewise of gaseous matter, is lost; so much so, that the dung is reduced one-half, and from that to two-thirds or more, in weight. Now, the principal elastic matter disengaged is carbonic acid, with some ammonia; and both these, if attracted by the moisture in a soil, and retained in combination with it, are capable of becoming nutriment.' Reasoning on which, he says—'that, within the last seven years, Mr. Coke has entirely given up the system of applying fermented dung; and he informs me, that his crops have been as good as ever they were, and that his manure goes nearly twice as far.' He then sums up his arguments with directions for the management of putrescent manure, in the following terms :—

'Where farm-yard dung cannot be immediately applied, the destructive

* British Farmer and Ploughman's Guide, 2nd edit., p. 68.

† See a very able inquiry into Sir Humphry Davy's theory in a treatise on soils and manures, Anon., p. 146.

fermentation of it should be prevented as much as possible. For this end the dung should be kept dry and unexposed to the air; for the moisture and contact with the oxygen of the atmosphere tends to excite fermentation. To protect a heap from rain, a covering of compact marl, or of a tenacious clay, should be spread over the surface and sides of it. Watering dunghills is sometimes recommended for checking fermentation; but this practice, although it may cool the dung for a short time, is inconsistent with just views, for moisture is a principal agent in all processes of decomposition: dry fibrous matter will never ferment. Water is as necessary as air to the process, and to supply it to fermenting dung is to supply an agent which will hasten its decay.' 'If a thermometer plunged into the dung does not rise above 100° of Fahrenheit, there is little danger of much aëriform matter flying off; if the temperature is higher, the dung should be immediately spread abroad.'

There is no ground for contesting the fact that a large quantity of fluid and of gaseous vapour is allowed to escape during the common process of reducing farm-yard manure to the state of short muck; but the practical inference deduced therefrom can only be proved by experiments on a much broader scale than those which have been yet submitted to the public.

The separation of a rich fluid substance, drained from a mass of dung, must, doubtless, diminish the fertilizing power of the manure in the proportion in which it has been extracted; but these drainings can either be preserved in tanks, and afterwards either thrown over the heap or applied to the land in their liquid form; or, should the construction of such reservoirs prove inconvenient, the waste of the liquor may be prevented by raising the dunghill in the manner already stated in our account of the preparation of farm-yard manure. The application of such moisture cannot be considered as a loss; and we have already seen that even that of watering dunghills is sometimes necessary to prevent them from becoming fire-fanged.

The escape of gaseous matter is caused by the heat created by fermentation; and if we look to the state of a farm-yard, we shall find that the moment the dung is thrown out, trampled upon, and wetted by the cattle, that process is commenced, although the temperature of the heap should be far below 100°. But although the bulk of the manure is thus diminished by the evaporation, yet the effect upon vegetation of the ammonia contained in the vapour has not been conclusively ascertained; nor is there any proof that animal and vegetable substances, while in a state of fermentation, contribute to its support; for it appears, from numerous experiments, that rank manure, although forcing the early growth of living plants, yet eventually contributes to their premature decay. Practice has long since decided that it is injurious to turnips, to which crop it is more profusely applied than to any other *: it renders corn crops foul; and on light and poor land which, containing but little nutriment in the soil, requires all that can be furnished to it by the manure for the support of the present plants, its effect, though often seen to occasion them to push

* Mr. Walker, of Mellendean, who rents about 2800 acres of arable land, has found by the experience of thirty years, that a small quantity of rotten dung is sufficient for a crop of turnips, and that all the succeeding crops, in the common rotation, are also generally good; but he could never raise a full crop with long fresh dung, which, from its openness, tends to admit drought, instead of affording moisture and nutriment to the roots, while they are young and tender. He is, therefore, at considerable expense in carrying out, turning, and re-turning his dunghills, so as to have the dung in a putrid state when laid upon the land in the month of June. After all he is every year obliged so to manure a part of his turnip land with fresh dung, *and whenever that is laid on, the crop is invariably much inferior.*—Husbandry of Scotland, vol. i. p. 161.

forth with great apparent vigour, yet frequently leaves them deficient in grain, and subject to rust. The potato is, indeed, almost the only plant to which it has been found decidedly friendly; but even that is in many soils known to succeed better with short dung.

Respecting the *effect of unfermented dung on Mr. Coke's crops*, it has been observed, in the treatise to which we have already alluded*, that the statement is only entitled to weight upon the construction either that some of the manure made on the farm that was expended under the old system is disposable for some other purpose under the new; or that some expense in fetching manure from distant places, that had used to be incurred, is saved. For, if the assertion 'that his crops have been as good as ever they were, and go nearly twice as far,' mean only that the dung when now expended is nearly twice as much in bulk or weight, and covers the surface of the field more thickly in the same proportion, the benefit is merely illusory, as the crop does not thus appear to be increased; but if the meaning is, 'that twice the surface is manured as effectually with the same quantity of dung'—then, indeed, we should say that the new plan may be fairly considered as entitled to the most serious consideration.

The same author, indeed, mentions an instance—cited in Dr. Thomson's System of Chemistry—of an experiment, from which it appears that the periods when putrescent manures begin to produce their effects, and the length of time during which they continue to operate, are proportioned to the degree of putrefaction under which they are applied. Two pieces, of the same kind of soil, were manured—the one with a mixture of dung and straw highly putrefied, the other with the same proportions of dung and straw newly mixed, and the straw almost fresh. It was then observed that, during the first year, the plants which grew on the putrefied dung produced a much better crop than the other; but the second year, the ground which had been manured with the fresh dung produced the best crop: the same result took place in the third year, after which both pieces seemed to be equally exhausted. This, however, only showing that the one was productive of the best crop in the first, and the other in the second year, proves nothing more than an equality of final effect upon the land: upon which it cannot escape reflection, that when the state of the soil does not require progressive improvement, the first crop is generally the main consideration with the farmer; he naturally, therefore, wishes to place it beyond the reach of those contingencies to which it might be exposed by any deficiency of effective manure. A knowledge of chemical principles, indeed, leads to the inference, that dung ought to be used in a recent state; and it has been thence assumed, 'that any disappointment which, in practice, may have attended the adoption of that inference, will be found to have arisen, not from a defect in the theory, but from a want of due observation of circumstances in its application †.' But whatever may be found in the writings of scientific agriculturists in favour of unfermented manure, the experience of practical men may, in most cases, excuse a doubt of its expediency ‡.

* Treatise on Soils and Manures. Anon. p. 145.

† Reports of Select Farms, in the Farmer's Series of the Library of Useful Knowledge: Kyle in Ayrshire, No. xi. p. 41.

‡ In the papers selected from the Correspondence of the Bath and West of England Society, there are queries proposed by the Board of Agriculture on several subjects connected with cultivation. The answer by one of their most distinguished members to that regarding manure, is as follows:—

'*What are the effects of dung and other manures upon the taste, flavour, and wholesomeness of vegetables?*'

Regarding the *application of straw*, which the Professor thinks 'should be ploughed into the soil in a fresh state, and that, in order to facilitate its mixture with the earth, it might be chopped small with a machine,' we deem it almost unnecessary to add anything more to the observations we have already made, except the record of an experiment made upon dry wheat-straw, which was regularly laid in the hollows of drills, and potato-sets placed over it. The straw and sets were then covered with earth, yet very few of the potatoes ever appeared above ground, and these only towards the end of autumn. When the ground was ploughed up, the straw seemed to have undergone no change, nor did it impart any sensible benefit to subsequent crops*. Had the same straw, however, been previously subjected to only a moderate degree of fermentation, there can be no doubt that its effects would have been very different; for, in most soils, potatoes thrive in dung which abounds in litter that has been very slightly fermented. Thus, if a quantity of straw be steeped for some days in water, till it become soft and pliant, and be then buried 2 or 3 inches under the surface of the ground, plants grown over it will assume a deep verdure; their growth will be vigorous, and this luxuriance will be continued until no traces of the straw are left. Sir Humphry may therefore be right in saying that, 'though this unfermented straw would produce less effect at first, yet its influence would be more lasting;' to which we shall only add that, however the land may be thus finally benefited, the immediate object of the farmer is generally *a prompt return.*

In fine, although coinciding in the opinion that the decomposition of putrescent manure may be—and is very generally—carried too far, and that its value is materially lessened by an excess of putrefactive fermentation, yet experience proves that, to a certain extent, it is absolutely requisite, though its positive effects upon vegetation are still so doubtful that the degree can only be ascertained by observation. The main agents of the process are water, heat, and air. If a dung-heap be much wetted, the operation proceeds very slowly; but when only moisture is retained sufficient to condense it, then it presently heats, and the fermentation proceeds so violently that, if not checked, a large portion of its bulk seems to escape by evaporation; though, if this be only the effect of the condensation of its materials, and if its weight be not also reduced, the residue may perhaps be thus rendered more nutritive. The opposite result may, however, be the fact; for it may be observed that, if a quantity of farm-yard dung be removed from a dunghill and turned loosely to the air, though it may be cool at first, yet, if moderately wet, it will soon generate heat; it will smoke violently, and emit a very pungent effluvium: from which it may be conjectured, that the nutritive properties of the manure would have been better preserved if it had not been exposed to further fermentation. Care should therefore be taken to preserve those exhalations from being dissipated, and it will be probably found that the object will be sufficiently attained if the vegetative power of seed-weeds be destroyed, and the fibres of the straw be reduced to the state of spit-dung.

' If the dung be completely rotten, the effects will be quickness of growth, succulence, crispness, and delicacy of flavour. I strongly suspect that the application of ill-digested manure to land is an evil productive of very great injury. Worms and grubs are multiplied thereby—the most noxious vapours are propagated; and, probably, the diseases in our grain crops may originate in this circumstance. I cannot believe that the delicate fibres of a root, making an effort to penetrate a clod of putrefying dung, can escape uninjured; and vegetable diseases, I presume, often commence at the root.'—Vol. ix. Art. xix. p. 235. ' I have known recent manure check vegetation.'—Ibid. p. 232.

* Farmer's Magazine, vol. xvi. p. 485.

Some fermentation will necessarily be ever going on in the dung-heap; but there is little danger of its being carried too far if the ingredients which it contains be well and properly mixed. If horse-dung alone be employed, it will soon proceed to an excess, occasioned by its own internal heat, that will deprive it of every fertilizing quality; but if mixed with the cooler dung of horned cattle, that risk will be in a great measure avoided. Then, if the dry contents of the covered sheds be also added to the mass of wet litter in the straw-yard, the whole mixture will undoubtedly not ferment beyond the point best suited to render it immediately available. 'In a large dunghill, of such a mixture, the heat of the active fermentation subsides in it long before any of its useful parts are destroyed, and long before even all the water which it contains is evaporated out of it; for, on examination, the manure will be found to be quite short, and easily lifted with the fork or shovel; while, at the same time, it will be saturated with the richest black-coloured juices, which appear to be the essential parts of urine deprived of their water *.' We, therefore, consider it as the opinion of a large majority of the most intelligent farmers, that dung should not be laid upon the land until it has undergone such a change as may be sufficient to destroy the seeds and insects which it may contain. This, however, cannot be effected except by a putrid fermentation, which, under common farm-management, cannot be completed until the heap be decomposed and cool; for otherwise, the operations of cartage, spreading, and ploughing in the manure, while in a state of heat, would dissipate the gaseous matter, and thus occasion the loss of that in which its nutritive powers are partly supposed to consist.

PRODUCE OF STRAW AND DUNG.

The *quantity of straw and haulm grown per acre* depends upon such a variety of circumstances touching soil and cultivation, season, and kind of crop, that it is quite impossible to form any precise calculation on the subject. Estimates have however been made of the average weight of different sorts produced by the various species of grain, from which a general idea of their gross amount may be formed. Although it is clear that nothing like accuracy can be expected on that point, yet it is in the power of every farmer to form a tolerably exact notion of the weight of all the straw and haulm actually grown upon his own land; and coupling this with the number of his live-stock and the nature of their food, he will probably be able to make out such a rough calculation of the *gross quantity of farm-yard manure* as may not be far from the truth. Such an account may indeed appear at first sight to be more curious than useful; but crops depend in a great measure on yard-dung, and their rotation must be regulated, on most soils, by its amount; it is therefore important to ascertain, as nearly as possible, the quantity on which a man who is dependent upon its production alone, without purchased manure, can rely, before he lays his plan for the ensuing year. The following are some of the estimates alluded to:—

31cwt. or 3472lbs.	wheat	160st. or 3520lbs.
25 „ 2810	beans and pease	130 „ 2860
25 „ 2800	oats	130 „ 2860
20 „ 2240	barley	100 „ 2200

Rye, about 3 loads of 36 trusses each, or 3888lbs.

The yield of different years varies the proportion which all grain and pulse bear to the straw; but the average of wheat is about 12 bushels to

* Quarterly Journal of Agriculture, No. xix. p. 83.

the *load*, which, according to the practice in most parts of England, consists of 36 trusses of 36lbs. each, and weighs 11cwt. 2qrs. 8lbs.; but, according to the above statement, the whole average of the kingdom is supposed to be about 1½ ton per statute acre *.

It has however been calculated by Dr. Coventry, the Professor of Agriculture in the University of Edinburgh, that arable land of a medium degree of fertility and management, is capable, in ordinary years, of producing, in round numbers, per imperial acre, about—

28 bushels of wheat,
36 do. of barley,
42 do. of oats;—

and that the average quantity of straw yielded by those crops will amount to 21cwt. He then states that, supposing this dry straw to be moistened and rotted, it would thereby gain an addition to its weight equal to two-thirds, or between three-fourths and two-thirds, of its gross weight—thus producing about 3½ tons of manure: and admitting that some corn is consumed in the feed of horses, as well as that the refuse of the grain, the chaff and light corn, besides the straw, go ultimately to the dung-heap, 'one cannot reckon the amount of the putrescent manure gained from an acre of such produce at more than 4 tons.' But, judging by the like proportion of moisture of different parcels produced by straw, pulse, hay, or herbage of any sort, 'it is likely that a full produce of turnips, potatoes, or cabbages, would furnish even a considerably greater weight †.' By an experiment very carefully made by Mr. Dudgeon, of Prora, in East Lothian, it however appears that dry straw had only increased by absorption from 300 to 719 stone, during a period of seven months; which is materially at variance with the Doctor's estimate of the addition to its weight. It seems, however, from the statements of several eminent farmers, that 1 ton of straw, when augmented in weight by the dung and urine of turnip-fed stock, will, if properly managed, produce about 4 tons of farm-yard manure ‡; but others, with more justice we think, are of opinion that such a quantity can only be produced when the common number of cattle on farms in the ordinary course of cultivation are also fed in the usual way —upon hay, clover, and corn, as well as turnips, besides being well littered with straw. Its weight and value will of course be affected by its state of preparation, as well as by the nature of the soil and its cultivation. Meadow-land which produces 1¼ ton of hay per acre has been calculated to give 6⅗, or rather more than 6 tons of manure per acre §, and the fallow crops produce a large amount; the land, therefore, without assuming any extraordinary degree of fertility or management, should yield, upon an average, at least 4 tons of manure per acre; to which if be added the extraneous substances which may, with due care, be collected without expense from the roads, the ditches, the ponds, and from refuse of every kind about the house and premises, the acreable amount should be amply sufficient for a full supply of manure once during every course of the four-years system of husbandry.

* Sinclair's Code of Agriculture, 3rd edit., p. 429; Survey of Middlesex, 2nd edit., pp. 220, 548.

† Quarterly Journal of Agriculture, vol. ii. p. 337.

‡ Sinclair's Code of Agriculture, 3rd edit., pp. 215, 440; Scottish Husbandry, 2nd edit., vol. i. p. 379, and *passim*. A Berwickshire farmer gives a single cart-load of turnips per day to eight or ten cattle in the straw-yard. He finds that, on an average of three years, from 2½ to 3 acres of straw will winter one of those oxen; and in this way each acre of straw will produce about four double cart-loads of rotten dung of from 30 to 35 cubic feet each.

§ Quarterly Journal of Agriculture, vol. ii. p. 337.

Dr. Coventry has also given an estimate of the average quantity of manure that may be procured from different crops, on land that, in common years, and under good management, may be supposed capable of producing 28 bushels of wheat, and 42 bushels of barley or oats, per imperial acre.

By clover, grass or herbage, hay, &c., first year . .	6 tons.
By do. if mowed, second year . . .	5½
By pulse-crops,—as beans,—part of the grain being fed by live stock	5½
By do. when the grain is sold . .	5
By white, or corn crops, as wheat, barley, &c., as an average of the whole	4

The manure is understood by him to be the common farm-yard sort, consisting of the dung and litter from the different offices, in a state only so far rotted as to be easily divisible by the dung-fork, and so dry as to have in it of moisture only about two-thirds, or perhaps a little more, of its whole weight, and to be capable of immediate application to the land *.

We fear, however, that, looking to the system of cultivation pursued on most farms, the quantity of manure produced falls far short of that amount. Much, indeed, depends upon its judicious management, for a good farmer will accumulate perhaps nearly twice as much dung as his more indolent and inattentive neighbour, and apply it in better condition to the land, though their opportunities are, in this respect, the same. No means should, therefore, be neglected to supply the deficiency; in which view, besides the extension of the soiling system, we should strongly recommend that corn crops should be cut as low as possible, so as to increase the bulk of straw. When the stubble is left high and ploughed in, it retards the operation, renders the land foul, and is, on some soils, injurious by rendering them too open. It is, indeed, in many places mown, and converted into walls for the comfort of the cattle. In Derbyshire a paring-plough is used, by which the roots of the corn and weeds are cut, and the stubble and other stuff is then carried home to be trodden into muck; but the produce does not pay the expense, and it has been found a more economical practice, when it can be carried into effect, to burn the stubble on the ground, by which insects and the seeds of weeds are destroyed. Even when raked up, it has been considered advisable to spread and burn it on the land, as it is thought to have a great effect in preventing the ravages of the fly on turnips †.

The following experiments on the *quantity of dung voided by cattle*—lately made under our own direction—will throw some further light on the subject.

The first was on a dragoon-horse, placed, at our request, by the Commandant of the Cavalry Depôt at Maidstone, in a separate box,—on the 26th of January, 1833,—and there kept, with one hour's exercise each day, during the following week, in which time the quantity of forage issued to him, and converted into dung, was as follows:—

Oats each day . .	10lbs.	=	70lbs.
Hay „ . .	12	=	84
Straw „ . .	8	=	56

* General Report of Scotland, vol. ii. p. 521. We have omitted the Doctor's estimate of the dung produced by pasture, as being irrelevant.

† See the Surveys of Essex, vol. i. p. 325; Huntingdonshire, p. 128; Derbyshire, vol. ii. pp. 124, 131, 406. In a work published about a century ago, and ascribed to Lord Belhaven, it is asserted that the goodness of the East Lothian crops was attributable to the length of their stubbles. 'A good crop of corn makes a good stubble; and a good stubble is the equallest mucking that can be given.'—The Countryman's Rudiments, p. 23.

He drank, within the week, 27 gallons of water; and, during his time of exercise, the loss of dung is supposed to have been 4lbs. daily, or 28lbs.: in which period therefore—

The total forage consumed amounted to	210lbs.
And the dung and litter produced was	327½lbs.

Thus—if the lost dung be added—yielding, with the addition of the moisture imparted to the litter by urine, an increase of two-thirds beyond the weight of the solid food.

The second—on the 28th of March, 1833—was on the food actually eaten by a large-sized Yorkshire milch cow, which was fed during four-and-twenty hours with the following provender—

81lbs. of brewer's grains,
30lbs. of raw potatoes,
15lbs. of meadow-hay.

The food thus amounted to 126lbs. She drank two pailsful of water, and the urine was allowed to run off; but she had no straw or litter of any kind, and the weight of the solid dung, which was carefully swept up, amounted to 45lbs.

The third was on the same cow, a week afterwards, but with a change of food, which was continued during some days, on the last of which she consumed within the four-and-twenty hours the following quantity:—

170lbs. of raw potatoes,
28lbs. of hay.

As in the former trial, no litter was allowed, and the urine was let off; but the solid dung amounted to 73lbs.

Although not incidental to the subject in question, it may however be worthy of remark that, although the cow was in perfect health, yet, on this latter food, her milk actually fell off at the rate of very nearly two quarts per day.

When cattle are well littered and fully fed with turnips, it has been usually found that about twelve of them will yield a one-horse cart-load of dung within twenty-four hours; but that quantity will scarcely be produced by sixteen, or even eighteen, if kept only on straw, with a small allowance of turnips. It has also been calculated that an acre of very good turnips, with an adequate proportion of straw, will make upwards of 16 cart-loads of dung; but 10 may be considered a sufficiently large average for the generality of those crops. Thus, it may be presumed that two acres will be required to manure one*.

An account by Arthur Young states that the winter stock on his own farm in Hertfordshire consisted of six horses, four cows, and nine lean hogs, which consumed 16 loads of hay, with 29 loads of straw for litter, besides, no doubt, the usual quantity of oats to the working cattle. The cows and store swine ran loose in the yard, and had their straw given in cribs; the horse-stables and fat-hog sties were cleansed into the yard: in May, the whole of the dung was turned over and laid into heaps, and in June was carted away. The quantity was 118 loads, each of 36 bushels†. The amount of manure which may be thus obtained is indeed so considerable, that forty-five oxen, littered, while fatting, with 20 waggon-loads of stubble, are said to have produced 600 tons of rotten dung; and so invariably has it been found that the value of the manure is in proportion to the nutriment contained in the food, that, on comparing the dung of cattle fed upon oil-

* Roxburgh Report, p. 134.
† Papers of the Bath and West of England Society, vol. iii. p. 3.

cake with that from the common farm-yard, it was found that the effects of 12 loads of the former, when spread on an acre of land, considerably exceeded that of 24 loads of the latter *.

COMPOST.

We have already observed upon the expediency of mixing the bottoms and crusts of dung-pies with the other materials of which they are composed when they are turned over; but the quantity may not only be greatly augmented by a larger addition of earth, but, by imbibing the juices of the dung, a *compost* is thus formed of excellent quality in its application to most crops, as well as soils, and especially to grass-land. It has indeed been objected to this, that the mixture of earth increases the size of the dunghill without adding to its virtue, while the expense of carriage is also thus unnecessarily incurred, and that the more manure is reduced to its essence the better. But, although this may, in some instances, be true, yet experience proves that a compost of this nature becomes converted into a very fertile mould, and in some sorts of unkindly land, small dressings are of little benefit. On such soils, portions of pure rotten dung get fast locked up in large clods, and are rendered useless to that crop; but the increase of bulk, by the addition of earth, admits of a much larger heap being applied, as well as of being more readily united with the ground by the plough, so as to render the tilth more manageable. In many cases, the mixture has been therefore found essentially useful; and though the charge of cartage is certainly an object of moment, yet that may be lessened by forming the composts upon the headlands of the fields to which they are to be applied. They may also be put together at any time of the year, which, especially in summer, is of itself an incalculable advantage. The ground should, however, in that case, be previously summer-fallowed, unless it be entirely free from weeds; or a small quantity of quicklime may be added to the earth, but it should not be allowed to come into immediate contact with the dung. When, however, the economy of carriage is not thought an object of so much consequence as to confine the raising of the compost to any particular spot, it will be advisable to select earth of the alluvial sort, which is always of a rich greasy nature, often mixed with marl, and well calculated to invigorate poor soils of a light and open texture: or loam: or, if nothing of the kind is to be had on the farm, then with earth of a quality as opposite as possible to that which predominates in the soil on which it is to be laid; and the whole should be well turned, so that it may be suitably fermented. The operation is thus performed:—

A bedding is formed of earth, or of sods with the grass uppermost, upon which a layer of fresh dung is placed—the fresher the better—about a foot in thickness; upon that another layer, equally as thick, is laid,—if of sods, doubled, with the grass sides turned back to back, so as to present one surface to the dung underneath, and the other to the next uppermost. In this manner the heap is raised to the height of 5 or 6 feet, when it is entirely covered with earth, but formed narrow, as well as high, in order to expose a large surface to the air. Sometimes lime is added, but, in that case, it should be either placed between two layers of earth; or, if between the sods, the grass should be reversed, and the lime be deposited between

* By another trial it appears that thirty-six cows and four horses, when tied up, ate 60 tons of hay, and had 20 *acres* of straw for litter, with which they made 200 *loads* of dung, in rotten order for the land; but the weight of neither the straw nor the dung is stated.—Complete Grazier, 5th edit., p. 100.

them, or between the earth and another layer of any other ingredient not so easily decomposed as the dung. The heap then ferments, and in that state it is left until it be completely cooled to the centre. When the heat has entirely subsided, the compost is to be then turned in such manner as that not only the uppermost part shall be underneath, but also that the outward portion be put in the middle, and that the whole be intimately mixed. If any part of the dung be dry, it should be well and equally wetted—if possible with urine, or with the drainings of the farm-yard,—as each layer is removed, and previous to their mixture. The number of turnings must depend upon the state of putrefaction of the dung, as well as that of the turf, if sods or other materials have been added. The proportion of dung, or other putrescible substance, to earth, must be governed by the qualities of both, and by the judgment of the farmer in their selection and use. The following—which has been adopted in Norfolk—will afford a general idea of the mixture of such a compost, when confined to mould and farm-yard dung:—

Mould for the bottom . .	160 loads.		
Dung from the bullock-yard and stables, a load of each alternately . . .		112 loads.	
Mould for the next layer .	42		
Dung for ditto		48	
Mould for the top and sides .	42		
Total .	244	+ 160	= 404 loads:

which, after being turned twice over, produced 300 loads of manure, and was intended for 20 acres.*

Another practice prevails among many farmers, which, so far as the production of manure is concerned, has the advantage of allowing the compost to imbibe the whole of the urine in the yard, but which is also attended with the inconvenience of bedding the cattle in a manner which, without great care in its frequent removal, must expose them to much want of comfort. It is as follows:—

Turf, or any other species of earth, is spread over the yard to the depth of upwards of 2 feet, except around the buildings, to the extent of perhaps 6 or 7 feet, which is left as a path. It is then covered with furze†, or fern, if to be had, and laid over with straw, to which the litter from the stables is also added, and upon this bed the feeding-cribs of the store cattle are placed. In this manner the dung is often allowed to accumulate during the entire winter, or until it rises to such an inconvenient height as to compel its removal; it is then either pi d in the yard, after being mixed and covered over with earth, and left there until it may be wanted in the autumn, or else carted out to the mixen, and there treated as already stated.

The materials, and the stock thus employed, were in one instance—

591 loads, of 18 bushels each, of earth	7 horses.
10 waggon-loads of stubble	7 cows
11 do. of fern	3 calves,
46 loads, of 36 trusses each, of straw	besides hogs.

The horses were fed as usual, and the other stock had cabbages in the yard. The quantity of manure which they produced, after it had been turned over

* Rigby's Framingham, p. 97.

† The bottoming of yards with furze has been objected to, because, if cut at an advanced period of its growth, it is extremely difficult to decompose. Where haulm and straw are scarce, it is, however, of great use in forming a dry bed for cattle; and when the dung is carried from the yard, the furze may be very easily separated, and placed in another compost with similar matters, or mixed with a small quantity of quick-lime, which will soon prepare it for use.

in the latter end of May, amounted to rather more than 1000 loads of 18 bushels; and the whole expense of cartage in and out, and the labour of turning and spreading, with the cost of the fern and straw, amounted to 45*l.* 11*s.* 10*d.*, which would probably be increased by present prices to about 60*l.*

In another, 136 loads of earth were laid in the yard, at nearly equidistant periods, from November to the end of March, to which were added the following materials, a large portion of which was consumed by the stock:—

5 waggon-loads of stubble	6 working horses.
25 do. of fern	4 cows.
The product of 4 acres of oat-straw	1 yearling and 30 sheep, besides lean hogs, fed on cabbages and turnips.
5 loads of do.	
19 do. of hay.	

The yard was kept littered about 6 inches deep with fern, to soak up the urine, and the dung from the stables and cow-houses was carried out and laid upon it,—hogs being the only loose stock allowed in the yard; but the thirty sheep were penned nightly upon fern only in one corner of it. The manure was not therefore trodden by cattle, but was piled up occasionally, as it accumulated, to the height of near 7 feet, when another heap was clamped up. The total amount, after having been duly turned, was 390 loads of 18 bushels (of which the sheep produced 23 loads), and the whole expense, including the charge of mixing and turning an extra quantity of 70 loads of the dung of a former year,—but not adding the cost of the hay,—was 25*l.* 18*s.*, which might amount at present prices to 35*l.* It must, however, be observed that it contained a larger proportion of dung than the former compost, and that this mode of preparation allows of its being got ready at different periods, without mixing the first portion with fresh dung; so that the first heap was in excellent order for use early in the spring *. Its precise effect upon the land has not been stated; but no farmer can be at a loss to conjecture its value, and from these data the cost of similar composts can be easily ascertained.

In using turf, or any kind of grass, in the mixture of a compost, it will be proper to recollect that, if taken up during most parts of the summer and autumn, it will not only be found generally impregnated with the seeds of weeds, but that grub-worms, wire-worms, and various other insects, usually select dry banks by the road-side, hedge-rows, or dry pasture, in which to deposit their eggs. When turf, or earth, is carried from such places, and added to the compost without having been previously subjected to the processes of tillage, the greatest care should be taken, either that it be turned up a full twelvemonth before it is applied to the land; or, as we have already observed, that quick-lime be strewed between the sods, in order to guard against every chance of their propagation †.

THE APPLICATION OF DUNG

to different soils and crops, though matter of wide discretion to the farmer, is yet a subject which admits of a few general directions.

Notwithstanding what has been already said respecting the practice of those farmers who allow this manure to lie for a long time upon the surface of the land, we however agree with the opposite opinion—that it should be spread the moment it is taken from the cart, and completely incorporated

* See Nos. ii. and iii. of the first article in vol. iii. of the Papers of the Bath Agricultural Society; and Holland's Survey of Cheshire, p. 227.

† See Blaikie's Appendix to his Essay on Farm-yard Manure, edit. 1828, p. 27.

with the soil *; for by tillage it becomes amalgamated with the inert particles of the earth, through which means both that and the dung form one substance in the fittest state of nourishment to promote vegetation †. It should not, however, be deep buried in the soil at first; for, though it is the prevailing opinion of many persons, that, by deep covering, the dung is defended from the injurious effect of exhalation—that the roots of plants soon find their way to it—and that it will be raised higher by after-ploughings,—yet there are men of accurate observation who, from long experience, have found that, if dung be only just covered, the nearer it is to the surface the greater are its effects in promoting fertility, for then it lies near the roots of young plants at the time when they need the most cherishing aliment. They also declare, that dung never rises to the surface after it has lain mixed for a season with the soil; but, on the contrary, that, as it dissolves in the earth, the solution descends as low as the soil has been stirred by the plough ‡.

It is another rule in the application of farm-yard manure, among good farmers, not to use a greater quantity at one time than may be supposed capable of producing a good crop; for, although land can hardly be rendered too rich for the production of green crops, yet wheat, barley, oats, and rye have often been so much injured by a profuse supply of dung, that they have run almost entirely to straw. We have lately seen wheat, on good and well-tilled land, in the possession of an extensive coach-master, which has scarcely yielded two quarters the acre, in consequence of the application of stable-dung; and it is well known that a good crop of grain cannot be grown upon a dunghill. It should not, however, be too sparingly administered, for if an insufficient quantity be laid on, it may not reimburse the expense; whereas a full supply will probably have the effect of producing an abundant crop. A medium should therefore be observed; but so much depends upon circumstances,—upon the strength of the manure, the nature of the soil, and the intended crop and culture,—that no precise amount can be stated. Various calculations have indeed been made by different writers upon the subject, but they are generally so vague, that they only estimate the quantity in *loads*, by which no precise meaning can be defined, for it must depend upon the size of the cart; and even when calculated in cubic yards, the weight will differ according to the state of the manure, though one cubic yard of well-rotted dung may be generally supposed to average about 11 cwt. A well-heaped one-horse cart will carry nearly a ton, and those drawn by two horses about 1½ ton; a small waggon is also commonly supposed to contain two cubical yards, each consisting of 27 bushels, when estimated by strike-measure, and twice as much if heaped; or a proportionate quantity in weight §.

On *strong soils*, farm-yard manure is very commonly applied to a summer-fallow for wheat; and when that process forms part of the rotation, it is the opinion of most intelligent husbandmen that it can at no time be

* Sinclair's Code of Agriculture, 3rd edit., p. 220; General Report of Scotland, vol. ii. p. 521; Brown, of Markle, on Agriculture, vol. i. p. 398.

† This has been exemplified by the observations of Marshall upon a crop of wheat of 4 quarters the acre obtained from his own farm, after peas, which had been dunged and thoroughly incorporated with the soil; while another field of wheat, sown at the same time, and fresh dunged with fine spit-dung, superior both in quality and quantity, but which had been ploughed in large lumps along with the seed, only produced 2 quarters.—Min. of Agric.

‡ Naismith's Essay on Manures, vol. ii. of the Appendix to the General Report of Scotland, chap. xii. p. 32, note.

§ In the General Report of Scotland the quantity of farm-yard manure usually

more profitably employed. The season is then so far advanced as to have afforded time for the preparation of the winter dung, which, on clay-land, where green crops are not generally grown, and the practice of summer soiling is not adopted, is otherwise a difficult matter; but when applied to corn-crops, it should be either already decomposed, or, if fresh, it should be allowed to remain so long in the ground, previous to the seed being sown, as to allow of its fermentation being completed; for it will otherwise occasion the growth of weeds, which, if not eradicated, may ripen before the ensuing harvest, and thus infest the land with future foulness. When the operation has been well performed, and the ground has been thus completely cleansed, it is then found to be so well divided, that, if minute attention be also paid to the spreading of the dung, it becomes so thoroughly intermixed with the soil as to ensure a greater return than if it had been laid on during any other periods. The practice is also not uncommon of laying it upon clover leys preparatory to a crop of wheat, or of spreading it upon green-sward a year or two before the land is broken up; but the advantages of this latter mode have been doubted by some, though many experienced practical farmers highly recommend it.

On *light land*, on which the rotation of crops usually commences with turnips, it has been found by experience that the dung should be well rotted; it is therefore generally mixed twice, in order to get it into a fit state; but, as Swedes are commonly put in the ground by the middle of May, the manure cannot be properly prepared by that time, unless the yards have been cleared during the winter, and much of that which is thus applied is over-year muck. This, when the crop is drilled, is laid as evenly as possible in the hollows of one-bout ridges, which are afterwards split by a double-mould-board plough, which covers the dung, by turning them over, and the seed is immediately sown above it; but when sown broadcast, it is regularly laid over the land, generally before the last ploughing, though some farmers give it a second stirring. When potatoes are planted, the manure used is almost invariably stable-dung, when it can be procured in sufficient quantity, which is laid in a shallow seed-furrow immediately under,—or, in some cases, over the cuttings; but care should be taken that it be put so deep in the ground as to be out of the way of the harrows, or, otherwise, their hold of the straw might occasion the sets to be removed from their seed-bed.

Even when bare fallows become necessary to clean the land, soils of this description are rarely dunged when followed by corn; for they are thereby rendered so open—especially if long dung be used—that the plants are apt to be thrown out by slight frost in the spring, and perish for want of a sufficient hold of the ground. This necessity for the employment of rotten

applied to fallows is stated to be from 14 to 20 double cart-loads, of about 1¼ cubic yard each—to the Scotch acre—equal, on an average, to about 14 per English acre; and from 10 to 15 for turnips: vol. ii. p. 519—521; which, it may be presumed, includes both light and strong soils.

Malcolm calculates in loads, which may be supposed to consist of a cubic yard for farm-yard dung, on the following soils and crops, per acre:—

	On strong lands.	Medium loams.	Gravels.	Chalks.	Sands.
For wheat	30	20 to 25	25	20	20
Barley	25	20	22	16	18
Turnips	30	20	25	20	20
Clover	15 to 20	15	20	16	16
Sainfoin	—	—	—	20	—
Pasture	15 to 20	15	16	16	16

Together with various other estimates for the separate dung of cattle and different materials.—Compendium of Modern Husbandry, vol. ii. p. 19.

dung not only lessens its bulk, but it must be also borne in mind that the same quantity of straw is not produced as upon rich clays; and although the deficiency of manure thus created may be partly made up by feeding sheep upon turnips, as well as by a smaller quantity being used than upon strong land, yet the exhaustion of light soils is more rapid; they therefore require more frequent replenishment, and no pains should be spared to increase the amount of dung.

On *grass-land* in the neighbourhood of London, where the finest meadow-hay in the kingdom is grown, dung of every kind is laid on in all states, both fresh and rotten; and much town-manure, or street-slop, partly in a liquid state, is thrown over the ground in the same condition as when taken out of the carts and barges. It is a cold, clayey district, lying on the north side of the Thames, in Hertfordshire and Middlesex, and has been brought to its present fertility solely by the aid of an unceasing application of manure; many of the farmers being under covenants in their leases to lay on a thick coat of stable-dung, thoroughly rotten, in every third year: others apply it fresh,—in which state it is said that, 'load for load, it is to the full as good as when rotten *,'—and after it has been washed in by the rain, the straw that remains is raked off and added to the dunghill. There can perhaps be little doubt that dressing the land with dung in a state of fermentation, when diluted with water, is the surest way of imparting nourishment to plants; and in that view, after the hay has been carried off the land, farmers watch for a change of weather, and, when the barometer indicates an approaching fall of rain, they lay on whatever manure they possess; but, if the season continues settled, the dung remains untouched until about the end of September, at which time it is applied while the ground is sufficiently dry to bear the drawing of loaded carts without injury, and when the heat is so moderate as not to exhale its volatile parts †.

In all these cases the product is abundant, because the land, though cold, yet grows good grass, and, whatever may be the nature of the manure, sufficient is always laid upon it to secure a crop; but it is only in the vicinity of the metropolis, or in other great towns, and through means of purchased manure, that such a supply can be obtained as that given to the land in question.

The use of compost of earth and farm-yard dung has been used as an argument against its employment upon meadow-land, because of the difficulty of its entrance into the soil, and that pure dung has a more immediate effect upon the crop. Upon land such as that just mentioned, the objection is well founded; but upon soils of a loose texture, the mixture of earth—particularly of clay—with the dung, by increasing the bulk to be laid upon the land, tends to bind it, and thus giving a firm hold to the roots of the grass, the finer sorts, which either have not strength enough to penetrate the ground, or the seeds of which have lain dormant, suddenly spring up, and the sward is thus improved. Of this a striking instance in point has been related by Mr. Dawson of Frogden, who, 'having occasion to carry a quantity of very fine black loam from a head-ridge of old in-field land, to give the surface-water a free passage, it was laid upon out-field bent-

* Survey of Essex, vol. ii. p. 231.

† Middlesex Report, 2nd edit., pp. 286, 287, 377. In the Leicestershire Report it is also said, 'Dung or compost should be laid on meadow-land immediately after the hay is carried off; for as at that time the ground is generally the driest of any time in the year, carting on it will not cut the turf: there is the least grass to destroy; it ensures good aftermath; and the winter rains will wash all the manure into the soil, so that it will receive the whole benefit of the dressing.'—P. 191.

grass-land adjoining, of which it covered about a quarter of an acre fully an inch thick. No grass-seeds were sown upon this new covering, yet white clover and other fine grasses sprung up, and gradually increased upon it; and the bent, upon which the loam was laid, diminished so speedily, that very little of it remained in the third year thereafter *.' It is, however, well known that the effect of dung is proportionately greater upon good than upon bad land, and the difference is still more considerable upon that which is under grass than what is arable; for it is observable that the dung of animals has scarcely any effect upon coarse pastures, but it perceptibly improves those which are covered with the finer grasses, and is of more or less value as herbage of the former or latter description predominates. This improvement is, however, far more sensible when aided by the application of lime, as we shall have occasion to notice when we come to treat of that fossil.

There is, indeed, evidently a mistaken practice throughout most parts of the kingdom with respect to the application of manure. The custom alluded to is that of laying it upon land of inferior quality, while that of a superior kind is in equal want of improvement; the better part of many farms being thus in some degree impoverished by attempting to improve, at an evident loss, the poorer parts. Others, indeed, follow the opposite system; but, when justice is done to the land, every part in rotation should receive the manure arising from its produce. There are, however, some rare instances of ground of so rich a quality, that by laying any manure upon it an injury would be sustained; but, upon the whole, it is an evident fact that any manure whatever—if not of a nature unsuitable to the soil—will be always attended with a proportionately better return when laid upon good, than upon poor land †.

In the *spreading of dung upon the land*, the common practice is to put it first out of the carts in hillocks, and afterwards to spread it upon the ground. Many farmers, however, take the opportunity of carting out their manure during a frost, and there leaving it in heaps until a thaw. The convenience of this is evident; and perhaps, during that weather, no great damage will happen to the dung, nor can much of its juices be imbibed by the soil: but if thus left, even for a short time, in open weather, the spots upon which it is laid get more than their share of the dressing, for the moisture is imbibed by that part under the manure, whilst the upper parts are dried by the action of the air, and lose some portion of their fertilizing power. Its effect is thus unequal; the crop will vegetate more luxuriantly on those spots, and the harvest will not be uniform. There is also this inconvenience in thus leaving it upon the soil—that, if the land lies upon a declivity, a considerable portion of the manure may be washed out by the rain, and either carried to the lower part of the field, or else lost in the ditches.

Another mode is for both the carter and the spreader to stand in the cart, and shake the manure out with forks; but although this has the advantage of a more ready distribution, yet, if the men drop a forkful by accident, or do not scatter a lump in the manner intended, they cannot stop to divide it, and it must lie where it falls. The repeated stoppage of the horses also occupies much time. Both these modes are therefore attended with inconvenience.

When carefully done, the distance to which the dung is to be carried to the field should be ascertained, and such a number of carts employed as

* Farmer's Magazine, vol. xiii. p. 60 † Holland's Survey of Cheshire, p. 243.

will give constant occupation to both the men and cattle: thus, supposing three to be sufficient, then two teams only—of whatever number—are to be worked, one going and the other returning, while the third cart is left standing at the dunghill to be filled, and replaced by the one which has returned empty, the cattle in which are then taken off and harnessed to the other, so that no time is lost. It should be spread immediately, and can never be done at any other time so cheaply. It is, indeed, decidedly the most economical method for the carter to spread it from the carriage; but as he cannot do this with the minuteness which is requisite to separate it completely and spread it equally over the soil, such a number of women or children, attended by an overseer, should be employed to follow the carts, as will effect this in the most perfect manner. That number will of course be regulated by the condition of the manure, the quantity to be used, and the distance from which it is drawn. The farmer himself, or some trusty person in whom he can confide, should not only determine the number of loads that are to be spread upon each acre, but should carefully regulate the distance which each load should cover, by measuring the quantity of land: this, when it is laid on in regular ridges, is very easily ascertained by pacing them, and summing up the length and the breadth of the ridges; and then it is only needful to direct the carter to make each load cover a certain space,—as one load upon one ridge, or three loads upon two ridges, &c. But if it is determined to lay down the manure in small heaps for the followers to spread entirely, in this case, the distance of each separate heap should be paced over and marked *. The regularity of the distribution of manure ought never to be intrusted to common labourers without superintendence. If the carter be employed, unless a boy be given him to drive, the necessary degree of equality can hardly be expected. It may also be sometimes advisable to lay a larger quantity upon one part than upon another of the same field, for the soils may differ; or it may lie upon a declivity, in which case it will only be prudent to put more upon the upper part than upon the bottoms; for, even under the most careful distribution, they assuredly will receive an additional portion, which will be swept from the heights. Care is also requisite, in carting out dung and all manure, to make the drivers keep on the head-land till they come to the end of the land which is manuring, so as to make each ridge bear its exact proportion of damage; or, for want of such attention, the men, if left to themselves, make roads across from the gate in every direction, to the great injury of the crop †.

Such is the most approved mode in the broadcast manner; but where the drill husbandry prevails, it is by no means unusual to lay the dung in the intervals of these small ridges, as practised for turnips throughout Scotland and the north of England. The drills are in this case generally formed at the distance of 27 inches, or thereabouts, from the centre of each; and by driving the carts along the middle one of the space intended to be manured, the dung is drawn out in such proportions as may be judged necessary. If the breadth of three drills be only taken at a time, the dung stands a better chance of being equally laid in them; for it often happens that, when a greater number are included in one space, the outside drills receive a less quantity than those which intervene. Others, however, thinking that by only taking three drills at a time, the travel of the horses is

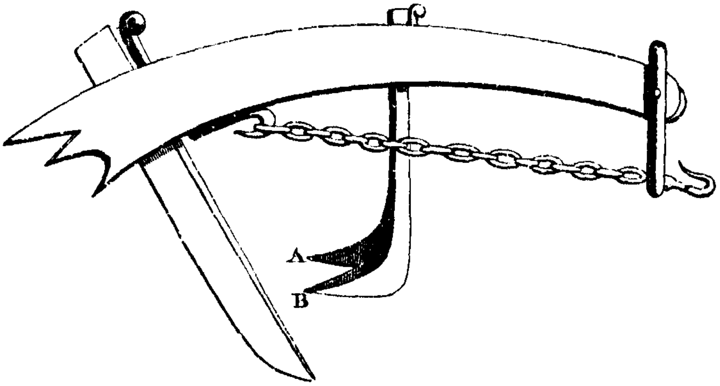
* A table, stating the number of heaps or bushels per acre, will be inserted at the close of the subject of manure.

† Norfolk Report, chap. xi. sect. iii.; Marshall's Midland Counties, vol. ii. p. 375 Brown, of Markle, on Rural Affairs, vol. i. p. 399.

unnecessarily increased, take five drills into one space ; but, in that case the number of spreaders must be increased, as at least one is requisite to each drill, and unless care be taken in the superintendence, some inequality will occur in the distribution. It is, however, obvious that the labour of the teams, as well as the poaching of the land, will be thereby lessened ; and if a sufficient number of spreaders be employed, the work will also be more speedily executed. Women and children, having light grapes, or forks, are strong enough—four are generally found sufficient for what is called 'a head of carts ;' and the spreading is adroitly performed even by small boys and girls, after they have been a little time accustomed to the task *.

It is obvious in the *ploughing down of dung* that, if it be not turned down accurately, it becomes partly exposed to the atmosphere, instead of being buried in the soil. Skim-coulter ploughs have been used to obviate this inconvenience, but—especially in the case of long dung—there is great difficulty in preventing it from choking the instrument, thus occasioning a great increase of draught to the cattle, as well as of labour to the ploughman, rendering the land foul, and defeating one of the main objects of good husbandry. It is also, by some farmers, thought expedient to bury fresh dung so deep below the soil as to allow it to ferment there without being disturbed by the harrows, or even by the shallow ploughing of successive tillage ; but, independently of the objection which has been already raised against that practice†, it is not, in any such case, found easy to make clean work.

Many attempts have been made to correct this fault, and considerable improvement has been effected in the construction of ploughs, particularly by the Scotch, some of whose iron swing ploughs have gone far towards a remedy of the defect. One lately invented by Mr. Finlayson, under the title of the 'patent self-cleaning plough,' which we shall hereafter have occasion to describe, seems to merit particular attention ‡. There is also an engraving, which has been noticed in the Farmer's Magazine §, and there called a 'depositor,' which consists merely of an addition to the coulter of any common plough by wings fixed in the beam, formed according to the following design. It is placed through a



* Farmer's Magazine, vol. v. p. 165. † See p. 259, l. 4.
‡ See Finlayson's Ploughman's Guide, with engravings, 2nd edit.
§ Vol. xvi. p. 162.

mortise in the beam, at right angles to the surface of the ground, when the plough is in motion; and the head projects 3 or 4 inches before the point of the coulter. It is fixed by a wedge, and may be placed so as to skim the surface of the land, or deeper if thought necessary. In order not to weaken the beam too much by the mortise, the coulter of the depositor is only a quarter of an inch thick, and 1½ inch broad, which is found to be sufficiently stout: the distance between the points of the feathers of these wings is 10 inches from A to B. We have not seen its operation nor heard of its effects; but it is so simple and unexpensive that it may be worth the trial, though the inventor admits that it is not found to act with sufficient regularity unless the dung be rotten.

As relating to the quantity of *farm-yard dung necessary for raising a course of crops* upon arable land of various soils, and under different systems of cultivation, with the proportion which they are capable of producing, it has been justly remarked by Dr. Coventry 'that ignorance, and wrong notions about the matter, have produced serious errors in practice; and the information concerning it found in books of Agriculture is in general scanty and seldom correct. It is, therefore, an object of primary importance to ascertain, as precisely as possible, what are the particulars that merit chief notice on the subject of cropping, the selection of the most proper species, the proportion that should subsist between them, and the most convenient order in which they should be raised *.'

The latter subject will be duly considered when we come to treat on the rotation of crops, and we have already noticed the average product of land of ordinary culture and fertility †; but, assuming some admitted facts as data upon which to ground our opinion of the quantity of putrescent manure which may be generally sufficient for an acre, we nearly agree in the opinion expressed by the Doctor, and collected from many other accounts, that from four to five tons are yearly requisite of that kind commonly prepared, and in its usual state of decomposition, as spit-dung. According to that calculation, it must also be observed that the course of crops is supposed to consist—on light soils, of the alternate plan of corn and green crops,—on clays which do not admit of that system, that the holding contain a proportionate quantity of grass-land; and that the quantity of manure should be supplied, not in small quantities annually, but in large ones, at intermediate distances of four, five, or six years. Light soils, in the common course of husbandry, rarely require the application of putrescent manure oftener than once in four years, and in all cases where the clover is allowed to stand during two seasons, it may be deferred without disadvantage for another year. Heavy soils may run six years without it, provided that the land be laid one year in fallow, and that there be sufficient meadow to be reckoned at least as one crop in the course. It being, however, clearly understood, that—whether on light or heavy land—nothing but grain, seeds, and live stock is to be sold off the farm, unless replaced with an equal portion of purchased dung; that the whole of the green crops, the haulm of pulse, and the straw of corn be used in the most economical manner; and that some of the live stock be either soiled or fattened upon oil-cake: which plan, if carefully pursued on good soils, with capital sufficient to secure an abundant working and fatting stock of cattle, ought, under fair management, to furnish an adequate supply of dung for any of the usual courses of culture.

Having thus submitted to our readers all that occurs to us of importance

* Essay on Manures, by Dr. Coventry. See the Quart. Journ. of Agric., vol. ii.

† See pp. 253, 254.

on the subject of farm-yard manure, we shall here recapitulate a summary of the chief points which we deem particularly worthy of their consideration :—

1. To bottom the farm-yard with furze, fern, dry haulm, or any other loose refuse that takes the longest time to dissolve; and over that to bed it deep with straw.

2. To occasionally remove the cribs of store cattle to different parts of the straw-yard, in order that their dung may be dropped, and their litter trodden, equally.

3. To spread the dung of other animals, when thrown into the yards, in equal layers over every part.

4. To remove the dung from the yard at least once, or oftener, during the winter, to the mixen.

5. To turn and mix all dunghills, until the woody or fibrous texture of the matter contained in them, and the roots and seeds of weeds, be completely decomposed, and until they emit a foul putrid smell; by which time they reach their greatest degree of strength, and arrive at the state of spit-dung.

6. To keep the dung in an equal state of moisture, so as to prevent any portion of the heap from becoming fire-fanged. If the fermentation be too rapid, heavy watering will abate the heat; but it will afterwards revive with increased force, unless the heap be either trodden firmly down or covered with mould to exclude the air.

7. To ferment the dung, if to be laid upon arable land during the autumn, in a much less degree than that to be applied before a spring sowing.

8. To lay a larger quantity on cold and wet lands than on those of a lighter nature; because the former require to be corrected by the warmth of the dung, while on dry, sandy, and gravelly soils, the application of too much dung is apt to burn up the plants. Stiff land will also be loosened by the undecayed fibres of long dung, which, although its putrefaction will thus be retarded, and its fertilizing power delayed, will yet ultimately afford nourishment.

9. To form composts with dung, or other animal and vegetable substances, and earth, for application to light soils.

10. To spread the manure upon the land, when carried to the field, with the least possible delay; and, if laid upon arable, to turn it immediately into the soil.

11. To preserve the drainage from stables and dunghills in every possible way; and if not applied in a liquid state, to throw it again upon the mixen.

12. To try experiments, during a series of years, upon the same soils and crops, with equal quantities of dung, laid on fresh, and afterwards rotted; in order to ascertain the results of their application to the land. The whole quantity to be first weighed, or measured, and then divided.

The fermentation of farm-yard manure is, in fact, a subject of far greater importance than is generally imagined, for on a due estimation of its value mainly depends the individual success, as well as the national prosperity, of our agriculture. The experiments to which we point cannot therefore fail to come home to the interests of every man; they may be made without expense, and without any other trouble than the mere exercise of common observation and intelligence. Leaving, however, aside the discussion concerning the disputed worth of fresh or fermented—of long or short

dung,—let the farmer sedulously bend his attention to the accumulation of the utmost quantity that it may be in his power to procure. The manner and the time of using it, in either state, must, however, be governed by circumstances which may not always be within his controul; and every judicious husbandman will rather accommodate himself to the exigency of the case than adhere strictly to his own notions of what he conceives to be the best practice. In fine, whether favouring the one or the other side of the question, let him collect all he can; apply it carefully to his crops; and then, trusting to events,—'*let the land and the muck settle it.*

CHAPTER XI.

PUTRESCENT MANURES CONTINUED.—NIGHT-SOIL—LIQUID MANURE.

NIGHT-SOIL

Is not alone distinguished from the ordure of all animals by the extreme fetidness of its smell, but is also known to be of a stronger or hotter kind, and probably differs in its own qualities in proportion to the sort of provision from which it is obtained, as there is every reason to suppose that the excrement arising out of animal food is of a more active nature than that which is the produce of a vegetable diet *. In all those places where the real value of this feculent matter is duly appreciated, and its preparation well understood, the aversion which its use excites is surmounted, and it is there preferred to all other manure. It has indeed been assumed that the excrements of a man, when used for this purpose, can be made to produce a sufficiency of corn and roots for his support; but, although that assertion has been exaggerated, yet were all the nourishment which could be extracted from this species of ordure made available, there

* 'Human ordure is full of oil and volatile alkaline salts.'—'The dung of carnivorous animals is also plentifully stored with oil.'—Hunter's Outlines of Agriculture, p. 13.

Arthur Young gives the result of two experiments on manures of different kinds and qualities, applied to potatoes on a poor gravelly loam, in the following proportions per acre, as follows:—

				First crop.	Second crop.
No. 1	No manure	.	.	120 bushels	140 bushels
2	Night-soil	10	waggon-loads, each 96 bushels	600 ,,	640 ,,
3	Do.	6	,,	650 ,,	500 ,,
4	Do.	2	,,	500 ,,	300 ,,
5	Bones	10	,,	650 ,,	640 ,,
6	Do.	6	,,	640 ,,	560 ,,
7	Do.	2	,,	560 ,,	240 ,,
8	Hog-dung	60	one-horse cart-loads	480 ,,	300 ,,
9	Do.	30	,,	480 ,,	160 ,,
10	Yard comp.	60	,,	300 ,,	240 ,,
11	Do.	120	,,	480 ,,	300 ,,
12	Do.	30	,,	140 ,,	140 ,,

Survey of Hertfordshire, p. 177.

Two nearly similar experiments have been also recorded by the Rev. James Willis, President of the Christ-Church Agricultural Society, in which the superiority of produce arising from the different sorts of dung was in the following order:—1st. That from pigs; 2nd. sheep; 3rd. horses; 4th. cows. In another, however, that from sheep was first, and pigs second; and Sir Humphry Davy gives the preference to that of hard-fed horses, then of sheep and deer, and lastly oxen.—Treat. on Soils and Man.: Anon. p. 128—131.

can be but little reason to doubt that it would add largely to the production of the land; for it has been proved, by numerous experiments, to rank far before the dung of any animal. In this country, however, it is very commonly allowed to become decomposed through want of care, and vast quantities are carried off by rivers from the large towns, and lost in the bosom of the ocean—an inattention which has partly arisen from the disgust occasioned by its odour, and partly through a prejudice to which that disgust has given rise.

This repugnance proceeds from an idea that this manure communicates an unpleasant flavour to plants grown in the land upon which it has been used; and it has been also thought to have a bad effect upon the soil. Both of these objections are however groundless when due care is applied to its management. Instances are indeed said to have occurred, in which horses have refused the hay made from grass which had been manured with night-soil; but, if credit is to be attached to the assertion, it must have been produced by its having been spread in a fresh state, and upon grass of very forward growth. In proof of this is an instance, mentioned in the Norfolk Report, of a field newly laid down to grass, every part of which proved very poor, except two acres on which four waggon-loads of night-soil were spread directly, without being mixed with any other manure. The field was fed off, and the effect of the night-soil is said to have been so great, that, 'while the rest of the field never seemed more than half filled with useful plants, this part thickened surprisingly, and grew most luxuriantly; so much so, that the cattle, neglecting the rest of the field, were perpetually feeding there, until by autumn it was pared down, like a fine green lawn by the side of a dusky, rough, ragged pasture *. In other accounts it is indeed reported as 'the most capital manure, of all other sorts, for pasture, two waggon-loads securing a carpet of herbage †;' and no bad effect is perceptible on vegetables, though kitchen-gardeners use it with profusion. It has been also asserted that nice judges of vegetables can distinguish a very unfavourable difference between the flavour of those grown in the vicinity of large towns or in the open country, and this they attribute partly to the use of night-soil; but it certainly communicates no unpleasant smell to the plants, nor even, after a very few days, to the ground on which it has been laid, for it is soon decomposed, and the effect complained of is doubtless more owing to the rapidity of the growth when forced by an excess of any stimulating manure, which renders them insipid; and were market-gardeners more sparing of the use of all dung, or were they to cor-

* P. 172. The same Survey also mentions the great improvement of a piece of sterile pasture by the application of night-soil mixed up with pond-mud, in the proportion of 7 waggon-loads of the former to 143 one-horse cart-loads of the latter. The soil was first laid upon the mud, the men then cut a trench through the heap, and throwing a small parcel into it, they worked it all to pieces. The compost was afterwards spread over the field at the total expense of 12*l.*; but at the present price of labour it would probably amount to half as much more.

† Survey of Essex, vol. ii. p. 241. One waggon-load, containing 90 bushels of night-soil, costs in London 15*s.*, to which is to be added the charge of carriage to the farms, to which it is mostly conveyed by the Thames, or by canals. Much of it is used in Essex, mixed with five times the quantity of fresh earth, and sometimes together with an equal quantity of the muck and chalk, in which proportions it is commonly used, at the rate of one waggon-load of night-soil; and the whole charge, including that of spreading, is calculated to be from 2*l.* 13*s.* to 3*l.* 3*s.* per acre. The common price of stable-dung in London is 2*s.* to 2*s.* 6*d.* per hay-cart load, containing between 70 and 80 cubical feet: that of street-slop, called *cold manure*, is delivered by barges to the distance of about fifteen miles, by the canals, or within reach of one tide by the river, at about 3*s.* per ton.—Middlesex Report, 2d. edit. p. 375.

rect it into a compost by a judicious mixture of lime and earth, or a small portion of slaked lime, the evil complained of would, no doubt, be removed *.

All unpleasantness of odour may indeed be prevented by the mere use of ashes; and were those thrown upon the night-soil, or into privies which have no communication with sewers, the ashes made in every dwelling-house would so completely absorb the fluid, that a solid heap of manure would be produced, that might be afterwards removed without difficulty or offensiveness. This, besides being common in many parts of the continent, is the regular practice throughout Hull †; and were it more generally followed in other towns, there can be no doubt that it would be attended with very beneficial effects to the agriculture of their neighbourhood. It is also collected in considerable quantities in London; and there was, a few years ago, a large manufactory for its preparation, in which it was dried and exposed to the sun by spreading it upon flag-stones gently inclined, to allow it to drain, after which it was broken into pieces, and removed under cover, where it was partially mixed with lime and completely reduced to powder. In this state it was packed into barrels, and exported even to our colonies, where it was used as a top-dressing, but was chiefly employed by market-gardeners, who used to sow it in drills along with their seeds, and, judging by the price at which they bought it, there can be no doubt that they found its use to be singularly advantageous; but the process has been abandoned, for, having been carried on in the heart of the town, it occasioned complaints of its offensiveness. This, from the inconvenience attending its conveyance, unless by canals, has greatly prevented its use: considerable difficulty has also been found in reconciling farm-servants to working at the preparation of this manure; but that objection can be easily overcome by a slight gratuity, and, considering its great value as a dressing, it ought not to be neglected. It is said that one load, in its dry state, will be, in all cases, quite sufficient for three acres of drilled wheat ‡.

Its operation has been found quicker and more powerful than farm-yard dung; but not so lasting. Farmers who have used both on adjoining land have observed that the crops are always more exuberant in the first year where the night-soil has been laid, but that little or no difference has been afterwards perceptible §. Its effects, when spread alone upon field-crops, and directly ploughed in with a shallow furrow, are indeed so violent, that grain manured with it has been known to run entirely to straw; yet it has been used in that state as a dressing for turnips, and also for spring-wheat, upon the fallow, upon thin and chalky soils, upon which the largest crop and the finest grain was grown upon a very extensive farm, upon

* Russell's Treatise on Practical and Chemical Agriculture, p. 205.—Derbysh. Rep vol. ii. p. 454. It is also contradicted by Count Gyllenborg, in his very erudite treatise on Chemical Agriculture, in which he mentions an instance of his having regularly watered a vine with putrid urine, but neither the grapes nor the wine contracted any bad taste.—Pilkington's Translation, p. 78. *Slaked-lime* is, for this purpose, preferable to that which is *hot;* for the latter, when combined with animal matter, forms a manure which is not soluble in water.

† See a letter on the subject, detailing the practice, together with remarks on its extension, in the Farmer's Magazine, vol. x. p. 497. Also the General Report of Scotland, vol. ii. p. 525; and Communications to the Board of Agriculture, vol. i. p. 317.

‡ The following has been recommended as the best mode of pulverizing night-soil: —'Spread it on a piece of grass; let it be well harrowed on a bright day; then put it under cover, and add a chaldron of lime to 4 loads of muck in that state, and it will become dry.'—Rigby's Framingham, p. 102.

§ Appendix to the General Report of Scotland, vol. ii. p. 82.

which it was laid to the extent of three waggon-loads per acre, though it probably was partly mixed up with the sweepings of streets *. It should however be incorporated with other substances; and as it is very difficult to procure it in any other than a nearly liquid state, it is proper that every means should be taken to secure it. A mixen should therefore be made, consisting of fresh loam, decayed tanners' bark, peat, or any other like substance, to the depth of about two feet, to which the night-soil must be drawn, and then carefully thrown over it with scoops to a moderate thickness; after which another layer should be added of loam, or a compost of the same substances, and in the same manner, though not quite so deep as before; then another of night-soil, until the whole has attained the proper height, when it is to be covered with the same materials, to which if a small quantity of quick-lime be joined, or mixed with the layers, it will assist the decomposition of the heap, and its nauseous effluvia will be destroyed. To every load of night-soil, about four or five times the same quantity of earth should be added, according to the nature of the soil, and to the degree of excitement intended to be applied to the land. It should then be regularly turned and thoroughly mixed, and may be used either for wheat or barley in the proportion of one waggon-load of night-soil, containing as much as four horses can fairly draw, to the acre; but it should be used more in the manner of a top-dressing than buried in the soil. It has been laid on in the large proportion of 40 double cart-loads, and has afterwards been known to produce 5½ quarters per acre of spring-wheat, besides an uncommonly luxuriant crop of rye-grass and clover in the ensuing summer †. It is sometimes, also, mixed with the yard-dung for the purpose of exciting fermentation: this, however, is not advisable, for it produces its greatest effect in an unfermented state, and when thus mixed its power is greatly lessened.

It is likewise converted into powder for the purpose of manure in Paris, and is also used throughout many parts of the Continent, but chiefly in the Netherlands, where, however, it is more commonly employed exclusively in a liquid state, of the preparation of which we extract the following account from the intelligent Report by Mr. Radcliff of the Agriculture of Eastern and Western Flanders ‡.

LIQUID MANURE.

'This consists of the urine of cattle, in which rape-cake has been dissolved, and in which the night-soil from the privies of the adjoining towns and villages has also been blended. This is gradually collected in subterraneous vaults of brick-work, at the verge of the farm next to the main road. Those receptacles are generally 40 feet long by 14 wide, and 7 or 8 feet deep, and in some cases are contrived with the crown of the arch so much below the surface of the ground, as to admit the plough to work over it. An aperture is left in the side, through which the manure is received from the cart by means of a shoot or trough; and at one end an opening is left to bring it up again by means of a temporary pump, which delivers it into carts or barrels. Another cistern, of double that size, is however

* Malcolm's Survey of Surrey and the Neighbouring Counties, vol. ii. p. 28.

† Farmer's Magazine, vol. xiv. p. 161. It will not escape observation that the amount of this manure would have been better stated if the quantity had been accurately ascertained in bushels; but that is a trouble which few farmers take, and information can only be given in the same manner in which it is obtained.

‡ Chap. iv. sect. ii. and chap. v. sect. iii.

for the most part formed under the range of stables, from each stall of which the urine is conducted to a common grating, through which it descends into the vault, from whence it is taken up by the pump; but in the best regulated there is a partition in the cistern, with a valve to admit the contents of the first space into the second, to be preserved there free from the later acquisition, age adding considerably to its efficacy. The smallest of them will hold 1000 barrels of 38 gallons each, and in that quantity from two to four thousand rape-cakes, of 2lbs. each, will have been dissolved.

'This species of manure is indeed relied on beyond any other upon all the light soils throughout Flanders; and even upon strong lands, originally so rich as to preclude the necessity of manure, it is now coming into great esteem, being considered applicable to most crops, and to all the varieties of soil.'

The crop upon which it is, however, chiefly bestowed, is *flax*, in the following manner and proportion. 'The field, after two or three ploughings and harrowings, is backed up in the centre, and ploughed round in but one set, so as to leave it without any furrow. A heavy roller is then drawn across the ploughing by three horses, the manure is spread equally over the entire surface, and, when well harrowed in by eight or nine strokes of the harrow, the seed is sown, which is also harrowed in by a light harrow, with wooden pins of less than 3 inches, and the surface, to conclude the operation, is again carefully rolled, so that nothing can exceed the smoothness and cultivated appearance of fields thus accurately prepared.'

The manner in which the manure is applied is in one or the other of the following modes, according to the distance. 'Where the cart plies, the manure is carried in a great sheet, closed at the corners by running strings, and secured to the four uprights of the cart: two men, standing one on each side, scatter it with hollow shovels upon the ground. Or, where barrels are made use of, each is carried by two men with poles, and set down at equal distances across the field, in the line of the rolling. There are two sets of vessels, which enable the men who deposit the loaded ones to bring back others empty. One man to each vessel, with a scoop, or rather a kind of bowl, with a long handle, spreads the manure so as to cover a certain space; and thus, by preserving the intervals correctly, they can precisely gauge the quantity for giving effect to any extent of surface.' It must, however, be admitted that this mode of application is somewhat clumsy, and that it might be improved. For the flax crop they are profuse, for they usually allow at the rate of 2480 gallons, beer measure, to the English acre*.

It thus appears that the dissolution of the oil-cake and a sufficient time for the thorough putrefaction of the contents of the cistern is the only preparation of this manure; and it is stated that 21 acres, upon a farm of 200,

* The average product of crops upon a sandy loam, and the quantity of manure for each per English acre, when applied to the land, is thus stated:—

Wheat, 22¾ bushels . .	Either dung or compost, 10½ tons.
Rye, 28¼ do. . .	Farm-yard manure, do.
Oats, 51⅝ do. . . .	Do. do.
Flax, 6½ do. of seed and stem, worth 17*l.* 16*s.* 9*d.* . .	866 cakes of rape, dissolved in 2480 gallons of urine.
Rape-seed, 32⅞ do. . .	580 do. dissolved in 3200 gallons of do.
Beans, 28½ do. . .	14 cart-loads of liquid manure and the same quantity of stable-dung, equal together to 21 tons.
Potatoes, 8¾ tons . .	Do. do. do.

—Radcliff's Report of the Agriculture of Eastern and Western Flanders, pp. 90, 91.

are most luxuriantly manured for crops of flax and rape with the urine—exclusive of the dung—of forty-four head of cattle*. It must, however, be borne in mind that, although the Flemings have too just a sense of the value of money to lay it out without the prospect of a profitable return, yet the construction of such a building as that described is calculated at about 120*l.*: in this country it would probably cost considerably more; and, as it cannot be removed, it will not suit the means of every farmer to be at the expense, unless he can obtain the assistance of his landlord.

In another account, drawn up in consequence of an investigation upon a very extensive Flemish farm, by persons appointed to examine the plan, (which had been objected to by several intelligent practical men,) it was declared, 'that, owing to the judicious concavity of the farm-yard, there was as much moisture as was necessary to ferment the straw; and it is now ascertained that liquid manure is the most efficacious of any, and produces a third more effect than what is spread upon the surface.' Hence, after the dung is fermented, they dilute it in water, and the liquid alone is carried to the field, and scattered over it. The earth immediately imbibes the liquid, which soon reaches the roots of the plants, and causes a rapid vegetation; whereas it is a long time before dung, in a solid state, fertilizes the soil. The straw that remains, after the dung is thus washed, is applied as manure for potatoes †. This mode has been, indeed, extensively carried on in other parts of the Continent, and its effects are considered as equally beneficial. There, by some farmers, water is regularly thrown over the dunghills, the oozings from which are allowed to drain into pits constructed for the purpose, and permitted to ferment before they are laid upon the land; or, by others, the whole of the dung and stall-litter is immersed in water, which, after a certain time, is pumped up from the pits, and applied in a liquid form; in which manner it is contended that this manure is not only more powerful in itself, but the quantity is thus doubled, for the solid contents of the dunghill remain the same. Experiments on an extensive scale have incontestably proved the efficacy of liquid manures upon sandy or other light soils, to which they impart consistency, and dispose them to retain moisture; nor can there be much doubt that in many cases the product of a single crop may be thus more than doubled, by its immediate contact with the plants.

On heavy land, we however coincide with the opinion of that eminent agriculturist the Baron de Thaër, from whom this account is taken, that it can never replace the solid contents of the dunghill; and, although not contesting the advantages of which it may be susceptible when applied to those soils and crops to which it is peculiarly applicable, we yet doubt the extraordinary degree of power ascribed to it. Before this mode of preparing manure be generally adopted, it should also be well ascertained whether the pains and expense attendant upon it do not overbalance those of our own common management; for although it is possible that, in the former way, a more complete decomposition of the materials may be secured, and that thus new combinations of nutritive matter may be formed, of the precise effects of which we are ignorant, yet, in our usual method of preparation, when properly conducted, nothing should be lost: the liquid drained from the dung should be collected for further use; and it is only upon such a calculation of the charges, as well as experience of the

* Sir John Sinclair, however, says, in his 'Hints on the Agricultural State of the Netherlands,' that in another farm it required the urine of 68 cattle, of various ages and 32 horses, to manure 40 acres.

† Ibid. p. 67.

effects of the manure, that a fair conclusion can be drawn regarding its real value *.

There is, perhaps, no part of the world in which the preparation and the practical application of vegetable and animal manure is so well understood as in China; but, owing to its overflowing population, almost the whole of the labour is performed by man, by which the number of working animals is so much reduced, that night-soil forms the principal dependence of the farmer. It is extensively employed in a dried state, and is sold, as an article of commerce, throughout the empire, in the form of cakes, mixed up with one-third of their weight of marl. It is, however, in its liquid state, as urine, that it is chiefly used, in combination with other substances, the account of which, as furnished by a gentleman who was long resident in the country, is too curious to be omitted.

Into a cask or jar is put a collection of putrid animal substances, consisting of flesh, fish, blood, &c., to which is added a certain quantity of urine, but the vessel is not completely filled. A mandarin, or officer of government, then attends, who, upon the vessel being closed, affixes his seal, and in which state it must remain for six months at least. When this, or a longer period, has elapsed, the mandarin removes his seal, and grants a certificate as to the quality of the preparation, which is shown by the proprietor, who cries it through the streets as a manure for gardens, and it is sold in quantities as small as an English pint. Before using, it is always diluted with four or five times its bulk of water, and it is extensively used for garden-crops, but universally in drills. The writer adds that he was informed by several intelligent Chinese, that human urine, thus prepared, forms a fourth part of all the manure employed in China, and which is never used until it has reached a high state of putridity.

That an article considered of so much importance in that country should in this, where agriculture has arrived at such great perfection, be so much neglected, is not easy to be accounted for. The quantity of urine voided daily by an individual of moderate size has been shown, by a series of experiments, to amount to about half a gallon, which, if due attention was paid to the collection of it, would, according to the Flemish mode of its application, be a sufficient manure for half a rood of ground. Urine, when sufficiently diluted with water, forms a food highly conducive to the growth of plants; it is, indeed, thought to contain the essential elements of vegetables in a state of solution †; but its state of putrefaction requires great attention. Thus, it may be observed that, in the hot months of summer, the pasture where the urine of cattle falls becomes marked by a rich dark green when rain falls soon after; but if the dry weather continues, the development of the ammoniacal salts, arising from the putrefaction of the urine, then occasions it to burn up the grass; yet, on the contrary, an excess of moisture deprives it entirely of effect. Thus, the whole of the urine from a dwelling-house having been daily thrown on a piece of pasture during three months of the winter, it was found in the following summer to differ but little from the state of the rest of the field—it having suffered too much dilution from the rain to be capable of putrefaction. But, in the following June, a week's urine being put into a jar, and covered with a slate, where it remained until it had completely undergone that stage, was then mixed with four times its amount of water, and, when sprinkled at proper times on the same quantity of pasture, it soon occasioned

* Principes Raisonnés d'Agriculture, tome ii. § 612; and note of the translator the Baron de Crud, p. 349.

† Sir Humphry Davy, Lectures, p. 257.

a luxuriant vegetation *. It produces similar effects on green vegetable crops—nourishing them when applied in a diluted state, but scorching them and destroying their tender herbage so effectually when unmixed, as to impede their growth. There is indeed but little doubt that nutritious manure of any kind may be carried to an excess which becomes prejudicial to vegetation, particularly in its early stages. Naismith instances the steeping of three peas for twenty-four hours in a teacupful of strong dung-juice, and three in plain water: each three were planted half an inch deep in separate flower-pots filled with garden-mould, and the liquid in which they had been steeped poured into the pots over them. Those which had been steeped in plain water appeared above ground thirty hours before the others. Both advanced, but those in the dung-juice had the most weakly appearance. When the plants were about four inches high, the lower leaves of those fed by the dung-juice fell off; and in about four weeks after the plants died, though they were daily watered, while those to which the water only had been administered continued healthy †. The haulm of a potato, too, the growth of which was pretty well advanced, fell off soon after it had been well wetted with urine in an advanced stage of putrefaction, and even the root itself was found reduced to a pulp ‡. It is, in fact, of a scorching quality, and its application to growing crops is not advisable during hot weather, unless mixed with a large proportion of simple water: of course it will not operate in the like manner upon fallow land, and it may be applied whenever the ground is in a fit state to absorb it readily, but much of its effect may be lost if it be not laid on at the time of sowing.

There is probably no species of manure so generally neglected, and yet so deserving of attention; for although the largest portion of what is produced in most farm-yards is there necessarily absorbed by the litter, and consequently profitably applied, yet large quantities are constantly allowed to run to waste. We have no means of ascertaining the amount of urine that may be voided by different animals in the course of a day, for the diversity of their size and of the kind of food on which they are supported would deprive such a calculation, upon a broad scale, of any pretension to accuracy. It has however been supposed that, if fed upon common white turnips, they yield about two-thirds of the weight—or about a gallon for every 12lbs. §—besides the water which they drink; and we have seen that the cow which we have mentioned produced, when fed on two-thirds of brewers' grains, only 45lbs. of dung out of 126lbs. of food, the greater portion of which was accordingly voided in urine. It must also be recollected that the cattle upon the farm to which we have alluded, in Flanders, consisted of only forty-four head, of which eight were horses, fed during the greater part of the winter upon dry food, yet they not only converted the entire produce of the straw and stable-dung into well-prepared compost of the usual description, which could not have been effected without a large supply of urine; but the savings from the stalls also furnished an additional quantity of liquid manure of the richest kind, equal to the culture of exhausting crops upon 21 acres of ground. It has been calculated too, in Scotland, that the urine of six cows or horses will enrich a quantity of earth sufficient to top-dress an English acre of grass-land ‖;

* Farmer's Magazine, vol. xx. p. 132. † Ibid., vol. vii. p. 301.

‡ Essay on Manures: Appendix to the Gen. Rep. of Scotland, vol. ii. p. 108.

§ The weight of pure distilled water is 8 lbs. per gallon: that of urine is heavier, in proportion to its composition.

‖ General Report of Scotland, vol. ii. p. 526. We cannot, however, avoid noticing the loose manner in which this calculation is supported; for the quantity of urine produced by six cows, or by the same number of horses, would be materially different.

but, considering the trouble and the prejudice attending it in this country, it is probable that the best way of preparing it for use is that recommended by a considerable farmer in Peebles-shire, who applies it in the following manner. He has a pit, about 12 yards square and 4 feet deep, which he fills with rich earth, or any such matters that may be at hand, and the urine of the cattle which he feeds is conveyed to the pit by a sewer, and spread equally over it. After this compost has received the greatest portion of the urine, which is about the latter end of April, when it is ready for the spring sowing, it is carefully turned over, when it shows symptoms of complete saturation; and in this way a large quantity of rich manure is raised, equal to about 280 cart-loads, 40 of which, per Scotch acre, when applied to the ground, he finds equal, if not superior, in its effects to his best dung. The expense of filling the pit only amounts to 6*l*.*

Throughout a great part of the rich low-lands in Tuscany, the manure is chiefly procured from night-soil, and preserved in large cisterns, in which it is steeped for several months in about three times its quantity of water; though some farmers content themselves with a large ditch, which is applied to the same purpose as the cistern. Into this every kind of putrescent matter is also thrown, and the putrid water thus produced is found to possess qualities of a very fertilizing nature. It is however principally used for garden-ground, which is thus watered every fortnight; and the plants, but more particularly onions, thus acquire a prodigious size, without being in the least affected by any bad flavour arising from the manure. Neither is its smell, though most offensive for a day or two after it has been laid upon the land, ever known to occasion any prejudicial effect to the health of the peasantry †.

In a paper addressed to the Board of Agriculture by Baron Schulenburgh, one of its honorary members, he states that in Sweden the urine is collected from the farm-offices, and pumped over dung and other substances while in a state of compost. The contents of the privies are likewise regularly collected by scavengers in all the great towns, and carried, in many instances, to the distance of forty miles from Stockholm. It is then diluted with water, and laid chiefly upon meadow-land; but it is also applied to green crops, and the effects on the soil, though gradually diminishing, are generally considered to last during four years ‡.

In Switzerland, also, the *mistwasser*, or manure-water, is sprinkled over the surface of the meadows by means of large casks and perforated water-troughs, immediately after each cutting of the scythe, which makes the grass to spring up again with great vigour in a very short time; and it is well known that water, rendered fetid by the solution of vegetable or animal substances, is essentially serviceable to grass-land, as may be commonly perceived by its effects when thrown upon the fields in the neighbourhood of stagnant ponds in which flax has been steeped. It is indeed highly probable that manures which are intended to act immediately upon the soil when laid on its surface, will have more effect upon grass-land when applied in a fluid state than in a solid form. It cannot, however, be denied that there are many instances on record in which no such consequences of its application have been remarked. Marshall relates an experiment conducted on his own farm with considerable care, in which the common drainage of the farm-yard—of course including rain-water—was laid upon two separate fields of young tares and clover, grown upon

* Mr. Alexander. See the Survey of Peebles., p. 169.

† Simonde, Tableau de l'Agriculture Toscane, p. 35. Derbysh. Rep., vol. ii. p. 209.

‡ Communications to the Board of Agric., vol. i. art. xxxi.

a sandy loam, at the rate of about 2500 gallons per acre the liquor was of middling strength, very high coloured and foul, but not puddly, and it was carried on in wet weather. No perceptible advantage was, however, observable on either those or the ensuing crops *; but the weather was not favourable. Some farmers, indeed, think these washings from the farm-yards, though of a brown colour, are yet, in most instances, so diluted with rain, as not to be worth the expense of carriage †; though other accounts of dung-water say, that, when permitted to trickle slowly upon the sward of meadow-ground, it renders the grass soft and luxuriant ‡. In an experiment recorded in the Bath Papers, two spots of meadow were equally measured, and watered three times a week during a month together of nearly dry weather—the one with dark-coloured stagnant water from a pond, and the other with clear river-water,—at the end of which time, the first was far better than the other. The crop upon that part of the field which had the foul water was strong and succulent, of a deep healthy green, and 18 inches high; while the other, though thick and high, was yellowish, weak, and faint. On being made into hay, and separately kept, the former yielded nearly double the quantity and of superior quality to the latter; and the same effect was visible in the following year §. There needs, indeed, no argument to prove that it must possess some fertilizing properties, but, except it be rich in quality, as well as abundant in quantity, it may be doubtful whether it be a profitable object of team labour.

Some extensive experiments upon the application of liquid manure—when confined to urine—have also been recently made in Scotland upon various crops, of which the following is a summary.

A cistern was constructed in the dung-court sufficiently large to contain the urine of from thirty-five to forty, and sometimes of seventy cows. The supply generally amounted to 360 gallons a week. When intended for use it was mixed with three or four times the same quantity of pond-water, and was taken out to the fields in a large butt containing 120 gallons, placed on wheels like a cart, to the hinder part of which there was attached

* Minutes of Agriculture, Digest, p. 23.

† It is stated in the Rutland Report by Mr. Parkinson, that the black water thus drained away from manure, has been tried frequently on land, without effect. He himself tried it, by having a dunghill made with a grip cut round it, with a descent to a kind of reservoir at one end of the hill, for this water to drain into, and then had it thrown back on that end, thinking thereby to preserve the loss of strength in the manure. But he found that when the manure which came from that side of the dunghill was laid upon the land, it was weaker than the other; and he therefore concludes,—'that when once this black water departs from the dung, that it is like blood let out of a vein, never to be applied again for the like purpose it was designed for in its original state.'—Surv. of Rutlandsh., p. 91.

This, however, was doubtless occasioned by fresh fermentation being occasioned by the dung being thus continually wetted, and thus losing its strength by repeated exhalation: but though it may be properly used as an argument for not thus applying even the drainage from manure, unless it should be in danger of becoming fire-fanged, yet that cannot be a motive for allowing it to run to waste.

‡ Bedfordshire Report, p. 505; Buckinghamshire do., p. 275.

§ Vol. i. p. 170. In pursuance of this experiment, the pond was drained and lined with clay, to prevent the water from oozing through it; drains were then laid into it from the stables, and into it were also emptied the contents of the privy and the offal from the kitchen, by which means the water became very putrid. A water-cart was then made, with a trough behind full of holes, and the meadow-land was watered with twenty cartsful, laid on either in the beginning of May, or after the cutting of the crop in July; the effect of which was superior, on both crop and rowen, to any other kind of manure.

Although the lining of the pond with clay was a good precaution, it might, however, be dispensed with; for, on draining the pond, the earth at the bottom would be found saturated with the drainage, and being scraped up, would make excellent manure.

a wooden box perforated with holes, through which the liquid ran out upon the ground in the manner of a common watering-cart.

No. 1.—When applied, in October, to *grass* which had been closely cropped by sheep *, the aftergrowth was not much increased, but the sward maintained a fresh green appearance during the winter, and it could be cut a month earlier than that which had not been so treated. Even in March it afforded a full bite; but should the grass be wanted for pasture, and not for cutting, the manure should not be applied later than December, as, when deferred until February, the cattle are rather shy in eating it.

No. 2.—The effect, when applied to *clover-lea*, to be broken up for oats, was very perceptible; the increase of crop being about one-third.

No. 3.—For *wheat* it answers well on a light soil; but on stiff or clay land it does no good. If laid on when the land is wet, it is also of no perceptible benefit to the wheat; but if applied under more favourable circumstances, that crop would probably be increased about one-fourth.

No. 4.—To *barley* its application was found injurious; for, although the bulk of the crop was great, yet the straw was so soft and weak that it lodged.

No. 5.—*Potatoes* grew to a large size, but they were watery and quite unfit for the table; though the application of a little dung along with the urine improved their quality.

No. 6.—On *turnips* it was not found half so efficient as fermented dung.

It thus appears that this species of liquid manure applies best to grass; a doctrine which is corroborated by the experience of Mr. Harley, the proprietor of the celebrated dairy near Glasgow, who says,—'that the advantages of irrigating grass-lands with cows' urine almost exceeds belief: last season some small fields were cut six times, averaging fifteen inches in length at each cutting, and the sward very thick †.' It was also found to succeed best after a shower, or when the ground was moist; but if laid on during sultry weather, it was advantageous to mix it with one-third of water; and although that was not thought necessary in spring or autumn, yet, judging from the quantity used, it may be presumed to have been rather profusely added. We learn, indeed, from Sir Humphry Davy, that, —'during the putrefaction of urine, the greatest part of the soluble matter contained in it is dissipated.' He therefore recommends that 'it should be consumed as fresh as possible, but if not mixed with solid compost, it should be diluted with water, as, when undiluted, it contains too much animal matter to form a proper fluid nutriment for absorption by the roots of plants.' This theory, it will however be recollected, contradicts

* The account from which this was extracted says 'that the quantity allowed was 20,000 gallons per imperial acre;' but on calculating the urine at 360 gallons per week, and presuming it to have been mixed with four times the same quantity of water,—as there stated,—the whole amount furnished during the year would only be 93,600 gallons; yet the extent of ground thus manured amounted,—

In the year 1828, to 40 imperial acres
,, 1830, ,, 46 ,,
,, 1831, ,, 50 ,,
,, 1832, ,, 80 ,,

of which the one half was watered again after the first crop of clover was cut in 1831 and 1832: there must therefore be an error in the quantity of urine. See the Quarterly Journal of Agriculture, No. xix. p. 95—97.

† Sir John Sinclair's Hints on the Agricultural System of the Netherlands, p. 63.

both the Flemish and the Chinese practice, which favours a protracted degree of fermentation; but he admits that 'putrid urine abounds in ammoniacal salts; and, though less active than fresh urine, that it is a very powerful manure *.' It cannot, indeed, be doubted that, in whatever state it may be found the most effectual, it is at least well worthy of attention, and we recommend it strongly to the consideration of all experimental farmers.

CHAPTER XII

MINERAL MANURES.—CHALK—LIME.

The manures which we term *alkaline* and *calcareous* consist chiefly of those substances which combine with acids, though generally with the loss of their distinctive characters, and out of which lime may be extracted by the process of burning. The extent of their utility is only ascertained by practice, which does not speak a uniform language in every place, for scarcely a farmer is to be found who is acquainted with the exact effect of their properties upon soils; from which it may be readily imagined that many will form erroneous opinions, arising out of the local circumstances of their own farms. Their chief advantage, in a natural state, seems, however, to be rather mechanical and alterative, than nutritive. They form a useful component part of the earth; and, in certain proportions, they are found to be essential to the fertility of most soils, or 'perhaps necessary even to their proper texture, as an ingredient in the organs of plants.†' The primitive constituents of which they are formed are composed of chalk, of limestone, or of the shells of fish—and on being submitted to the action of fire, lime is produced.

CHALK

Is a pure calcareous earth, though in almost all cases mixed with particles of clay and sand, which deteriorate its quality, in whatever proportion they exist; it is therefore highly important that the farmer should ascertain those proportions, for, when combined with clay, such chalk is most fit for light loams and sandy soils, which it tends to unite, while stiff lands will, on the contrary, be proportionably most benefited by the opposite mixture, and should be applied in the different proportions which the respective qualities of each seem to require. It is, however, frequently laid without discrimination upon every kind of land, though the proper number of bushels necessary for each particular soil can only be accurately determined by a discriminating knowledge both of the different properties of the chalk and of the ground to which it is intended to be applied. From ignorance of this, farmers are generally without any rule to guide them in its application; but supposing them, from long experience, to have discovered the exact quantity of some particular chalk proper for their own soil, this knowledge can only be local, and cannot enable them to decide upon its effect in other situations ‡.

* Elements of Agricultural Chemistry, 4to., p. 257.

† Sir Humphry Davy. Ibid., p. 19.

‡ 'Pure chalk, being saturated with carbonic acid gas, tends to alter the original disposition of the parts of the soil, where it meets with various substances, either vegetable,

When unmixed, its properties in all respects resemble those of pure lime, and the chief motive for burning either that, or limestone, is that it may be thereby the more easily reduced to a state of powder, and spread upon the ground, by which it can be rendered a more effectual dressing for the land. The operation also considerably reduces its weight by the evaporation of the water contained in it, so that, in cases of very distant carriage, the cost of fuel may be saved by the difference in the expense of conveyance. The cost of delivery from any great distance is indeed so considerable as almost to preclude its use, except in the immediate vicinity; and even there it is usually carted upon the land during hard frosts, when the teams are not otherwise occupied. When laid upon the land in the simple state of chalk, it is also apt to become hard by the drying effects of the wind and air, and as it is dug up in large lumps which cannot be reduced without considerable labour, it thus remains for a considerable length of time, without producing its intended effect upon the soil. When thus used, therefore, it should be taken from the pit in either the latter part of the autumn or the beginning of winter, while its pores are full of water, for if frost then comes on, it becomes expanded in the act of freezing, and thus bursting suddenly, it crumbles partly into a kind of slime. This, however, leaves the operation to chance; it is, therefore, better to break the chalk into as fine pieces as possible, for otherwise, being exposed to the winds of the spring months, it becomes so dried and hard, that the harrows will take no effect upon it, and to roll it will only serve to compress it into the earth without breaking it. By this irregularity, too, in its division, a great deal of the seed would also remain uncovered, and its period of ripening being thus more forward where the manure was laid than where the land was left bare, a portion of the crop would be ready to be reaped while the remainder might be still green.

From this difficulty, the use of chalk has been much discontinued, though the fault is not so much in the chalk itself as in the manner of treating it. Regard must necessarily be had to the quality of the chalk, to the tenacity of the soil, and also to its state of poverty or improvement. The quantity laid upon the land is variable, and more governed by convenience than by any scientific notion of its properties: from 400 to 600 or 1000 bushels, and even more, is by no means unusual. It is very commonly laid upon coarse sour pasture at the rate of 150 to 250 bushels per acre, upon which it almost uniformly effects an evident improvement, bringing it from a rush-like appearance to a fine, sweet, and delicate herbage, intermixed with white clover and the richer grasses, which otherwise remain dormant in the ground. The same good effect is also found when applied to hot gravelly loams, where its cooling properties counteract their tendency to burn in the summer months; and on land subject to sorrel it is a sovereign cure, killing that weed speedily—a circumstance favourable to stock, for it is very unwholesome to sheep, and many lambs are frequently killed by eating it *. It also imparts a mellowness and friability to clays and other strong soils, which prove advantageous to the growth of most kinds of corn, and it likewise assists the adhesiveness of sands,

table, animal, or mineral; these substances becoming oxygenated by their action with the chalk, generate their several acids, and these acids disengage the carbonic acid gas, which is readily absorbed by the roots of the plants; it therefore tends, by slow degrees, to separate the cohesiveness of the strong soil, and to admit the roots of the plants to feed upon the carbon with greater facility.'—Malcolm's Comp. of Husb. and Anal. of Manures, vol. ii. p. 32.

* Malcolm's Survey of Surrey, Kent, and Sussex, vol. ii p 30- 39 Young's do of Hertfordshire, p. 161.

but it can never be usefully applied to land of the same nature as that from which it is drawn: its efficacy is therefore proportioned to the deficiency of calcareous matter in the natural soil.

It is not however possible to get hard chalk thus to break entirely into small pieces, and much of it will remain, perhaps for years, without being reduced by the weather: if, therefore, it be intended to produce the same immediate effect as lime, it should be applied in perhaps three, or even four times the same quantity; but its decomposition being more slow, it will also be more lasting. When found of a soft and unctuous quality, it has been laid with remarkable effect on gravel mixed with a small portion of clay, in sufficient quantity to afford a covering of an inch, or an inch and a half, in thickness. Previously to its application, this land was so extremely precarious in its produce, that, although manured, folded abundantly, and trodden by sheep to condense the soil, the expense and care bestowed upon it were rarely compensated by a corresponding return. The wheat grew freely at first, and continued to bear a very favourable appearance until the spring, when the ground assumed a spongy, hollow texture, the plant acquired a dark brownish hue, died in considerable quantities, and only produced from 12 to 16 bushels per acre of light corn, with the straw invariably stunted and blighted; but the same land now yields from 24 to 30 bushels, of excellent quality. The barley, oats, tares, and clover suffered in the same proportion, and have equally derived benefit from the chalking; nor has there been any recurrence of the former unhealthy condition of the soil *.

When employed for the purpose of chalking the surrounding land, it is usually dug out of pits, which are sunk to a considerable depth, by contractors, who travel over the different parts of the country where it is generally found. The common practice on such farms is to fix upon a spot nearly centrical to about 6 acres of land, where a pit, about 4 feet in diameter, is sunk to the chalk, if found within 20 feet from the surface; if not, the contractors fill it up, and sink in fresh places, till their labour is attended with better success. The pit, when sunk, is kept from falling by a sort of basket-work, made of brush-wood, cut green to make it the closer; it is then chambered at the bottom—that is, the pitman digs or cuts out the chalk horizontally in three separate directions of sufficient height and width to admit of their being worked with safety. The labourers are generally three in number—one of whom digs the pit and fills the basket, which is raised by a pulley of very rude construction, which is then wound to the top by his companions, who alternately wheel its contents upon the land. In some places 18 barrowfuls, and in others 16 buckets, which each hold 1½ bushel, are deemed a load, 100 of which are considered as the full extent of chalking an acre, though 40 to 60 is a more usual quantity. The expense varies according to the depth of the chalk, as it is found to be better the deeper it lies, and when only 3 or 4 feet from the surface, it is generally so indifferent as to be again thrown into the pit when filled up. In the chalk districts it is very commonly applied at periods varying from a dozen to twenty years, and with equally various accounts of its success, though its first application is always admitted to be the most effectual. When well mixed with the land, it is generally acknowledged to make it work much better, and with less strength of cattle on heavy ground; and if assisted with dung, or with occasional spring-dressings, to quicken vegetation, it is very universally allowed to improve

* See Mr. Gawler's account of his farm in North Hampshire: Library of Useful Knowledge, Farmer's Series, No. 7.

the crops: its value is often estimated between outgoing and incoming tenants, when lately laid on, as high as 6*l.* per acre *.

LIMESTONE.

The *properties of limestone* are similar, though it is very generally believed that lime made of very hard limestone is more efficacious as manure than that which is made from materials of a softer nature, and hence it is commonly asserted that lime made from chalk is much weaker †. In some places, however, chalk-lime is preferred. Thus we are told by Mr. Boys that, although there is excellent limestone in the centre of the Weald of Kent, yet lime made of chalk is brought from the distance of twenty miles. This might be attributed to a knowledge of the superiority of its practical effect, as ascertained by its greater purity and consequent strength, but it would rather appear that the preference arises from caprice, for he also says that chalk is even carried for a considerable distance to the parish of Bethersden, which is famous for a fine limestone ‡. The fact, however, is, that whichever contains the greatest quantity of calcareous matter will be found to be the strongest. If employed without being burned, its effects upon the land are very slow: it acts upon the soil during many years as a mild calcareous earth, but its duration and effects are proportioned to its purity, as the less alloy which it contains, the stronger will it be, and the operation of changing it into lime is of no farther use than as a mode of rendering it more promptly effective. It is also the least expensive wherever fuel can be obtained at a moderate price; for its weight is thereby reduced to nearly one-half, and it cannot be brought into use as manure without being reduced to powder, the labour of which is very great, while the weight, and consequent charge of carriage, of course remain undiminished §.

Limestone, however, is found in great abundance in many places in which there is a great scarcity of fuel; and a scheme was accordingly suggested to the trustees of the forfeited estates in Scotland by the late Lord Kaimes, for the erection of a crushing-mill, by means of which great masses of rock, when broken into pieces, were reduced to powder. It was erected in the Highlands, at a period when there existed but little spirit for improvement, and we learn from Dr. Anderson that, 'as there was no public demand for the manure, after the experiment was sufficiently tried to show that it might be practised with advantage in other places, the mill was suffered to lie unemployed ‖;' but it is said, in the Survey of the County of Perth, that the machine was swept away by a flood before the benefits of the process could be sufficiently understood. It might, however, be well worth the while of extensive proprietors of land, which is locally deprived of the assistance of lime by the want of coals, or peat, to erect similar machines, as few doubts can be entertained of their utility; for though unburnt limestone, when reduced to powder, has not the same activity as that which has undergone the action of fire, it is yet a valuable article, and, as

* Herts. Report, p. 156; Bucks. do., p. 269; Beds. do., p. 495; Berks. do., p. 361; Essex do., p. 205; Kent do., p. 158.

† Anderson's Essays, 4th edit., vol. i. Essay vi. part ii.

‡ Boys's Survey of Kent, 2nd edit. p. 89.

§ Dr. Anderson says *two-thirds*, ib. p. 497; but this is upon pure limestone, and immediately after it has been calcined, consequently before it can have acquired any moisture from the atmosphere; the more common calculation is therefore about *one-half*, or perhaps *two-fifths*.

‖ See a description of the mill in his Essays on Agriculture, vol. i. p. 496, 4th edit.: also an engraved plan for a similar machine in the Farmer's Magazine, vol. iii. p. 146.

a gradual improver of the soil, it may even be rendered more useful than quicklime.

Limestone gravel is also an article among our manures which is deserving of consideration. It consists of masses of stones, pebbles, and sometimes of slate and ragstone, resembling a concretion of small stones, or gravel, which, when spread upon the ground and mixed with it, gradually disunites and fertilizes the soil, according as the gravel crumbles down and mixes intimately with it. It is chiefly used on stiff clayey soils, and has been eminently useful in the improvement of boggy and wet bottoms, from which the water had been previously drained. In many such instances it has been found a better and more lasting manure than marl, mellowing and correcting the tenacity of the clay, and producing the white and purple trefoil where sour grass grew before. It is common throughout many parts of Ireland, and in some of the English counties, but it is not generally known in Scotland *.

FISH-SHELLS.

The *shells of fish*, when burnt, produce the purest species of lime, but they are more commonly employed in a pounded state, in which they may be so advantageously used, that oyster-shells, when crushed and drilled upon 27-inch ridges, at the rate of 40 bushels per acre, produced as fine a crop of turnips as another field of the same land, manured, for the sake of the experiment, at Mr. Coke's, at Holkham, with farm-dung at the rate of 8 tons per acre; nor was there any apparent difference in the succeeding crops of barley and clover. The powder has also been tried at the same farm, for wheat, in competition with rape-dust—both powder and dust at the rate of 4 cwt. per acre, each drilled on a light gravelly loam, in both spring and autumn. The crop was not, in either case, measured, but there was no perceptible difference in either. The field was afterwards sown with turnips, and the produce proved a good crop †. Yet, notwithstanding the result of these experiments, no fair conclusion can be drawn from them regarding their respective effects, as manure, in that sense in which it is understood to mean nutriment; for, although lime may excite the powers of other nutritive matter in the soil, and thus promote vegetation, it possesses no substance, within itself, which can impart nourishment.

In some places these shells are found in large beds almost entire, and they may be then either ground by passing them through the oil-cake crusher, or broken into pieces by repeatedly drawing a heavy stone or iron roller over them when spread upon a floor of flags or clinkers. There is, however, a more economical mode of attaining the same object, which is by merely making them the lower tier of a dunghill, or by spreading them at the bottom of the farm-yard, in which the drainage of the urine will decompose them, and in that state the manure will possess all the advantage of a compost with lime ‡. They may also be used whole on stiff land or clay, on which they act mechanically, opening and loosening the clods, and by that means making way for the roots to penetrate their fibres. To such land they will be found very serviceable, and as they moulder gradually, every year a little, until they are quite spent, they wear down slowly, and their effects, when laid on in sufficient quantity, are long perceptible; but they should not be applied to sandy ground.

* General Report of Scotland, vol. ii. p. 537; Survey of the County of Dublin, App. p. 17, from Dr. Rutty's Nat. Hist. of the County.

† Extract of a letter from Mr. Blaikie, Steward to Mr. Coke of Holkham, to Sir John Sinclair, dated Sept. 18, 1818.

‡ Communications to the Board of Agriculture, vol. vi. art. iii.

On many parts of our coasts, *shell-sand* also forms a valuable species of manure, for the shells which are deposited at the bottom of the sea become there in time decomposed, and the sand which is within reach of the tide, being thrown upon the shore in storms, is, in some places, carted off, and laid upon the land with considerable advantage, though in other parts the practice seems utterly unknown. Being finely attenuated, it blends intimately with the soil, and thus produces very sensible effects in the correction of cold clays and cohesive loams, on which it is usually laid to the amount of about twenty tons per acre. Its chief value will, however, be proportioned to the quantity of calcareous matter, or of shells, which it contains, and this is in some places found to be so large as nearly to equal the common properties of lime *

It is also found in strata, imbedded in sand-cliffs, at the height sometimes of 40 or 50 feet above the level of the sea, in which places it is generally denominated *crag*, and was, no doubt, deposited in former ages, ere the water had receded from the shore.

LIME

Is applied to a great variety of uses: it is employed in medicine as an anti-acid; mortar is composed of it, when combined with sand; and it serves as a manure, which is the only view in which we now have to regard it. When used for the purposes of agriculture, it is formed by exposing the substances we have mentioned to a certain degree of heat in the furnace, or kiln, of the lime-burner. When this has been continued for a sufficient length of time, their weight becomes considerably diminished, though they retain their former shape and bulk; and either limestone or chalk, when thus reduced, is in most places known by the name either of *lime-shells*, or *shell-lime*, or simply *shells*. In this state it is called *quick-lime*: the materials of which it is thus composed possess hardly any active property, but when burned, it then becomes caustic to the tongue, and effects the speedy decomposition of most vegetable and animal bodies. When applied in this form—either in the way of compost, or spread over the soil by itself—it is so far from affording nutriment to anything that may be there growing, that, were its effects to be long continued, it would consume it. But if water be thrown upon it, a great degree of heat is in a short time generated; the burnt shells begin to crack and burst asunder, and the mass gradually crumbles down, or falls, as it is more commonly said, into a fine powder, which becomes white, of whatever colour it may have been before it was calcined. Or when it has been exposed for a short time to the influence of the atmosphere, it is also found to lose this caustic power, and it is thus reconverted into a substance of the same mild nature as that from which it was obtained—in all its properties exactly resembling chalk †.

This operation is called *slacking*, or *slaking*; and lime, when deprived of its scorching quality, is termed *slaked-lime*, or, in the language of chemists, *effete*. Instead of watering it in heaps, the practice which generally prevails is to lay the shells upon a fallow, in small hillocks of about a bushel and a half each, either thrown up around the circumference of each heap, or covered up immediately with some fresh soil made very fine, which,

* Survey of Cork, Add., p. 45.

† See Hornby on Lime, p. 10; Dr. Anderson's Essays relating to Agriculture, vol. i. Essay vi.; and Sir Humphry Davy, Lect. vii. When moistened with sea-water, lime yields more alkali (soda) than when treated with common water; and is said to have been used in some cases with more benefit as manure.—Ibid., p. 298.

when laid on moderately thick, should be clapped close down with the back of the spade, so as to exclude the admission of either air or rain. In this state it may remain for a few days, care being taken during that time to keep every part of the heaps tight and sound, when it will be found that the moisture of the earth will have completely slaked it. Although it may be thought that this covering of the lime is unnecessary, it yet has this use—that without it the rain would form crusts over the heaps, which would not only prevent the moisture from penetrating regularly through them, but would also hinder them from being pulverized without considerable difficulty. It will then be fit for use, and when spread over the field it should be immediately ploughed in with a shallow furrow, and well stirred with the harrows in every direction. Upon an 18-feet ridge these heaps will be the same distance, or 6 yards, asunder, from centre to centre, if about 200 bushels be laid on per acre, and so on when other quantities are applied. Instead of slaking the lime in this manner, it has however been recommended 'to lay it down in a long heap, or mound, on one side of the field on which it is to be applied. Two labourers are then employed to turn the mound, and a third waters it. When the whole has been thus gone over, it is allowed to lie for four or five days, after which it is again turned, and if any part of the lime should be found to be still unslaked, more water is added*.

From this it will be perceived, that one chief cause which renders the burning of lime necessary arises from the extreme difficulty of obtaining the powder without the process of grinding; but by being thus more finely divided, it can also be more evenly diffused over the soil, with which, therefore, it becomes more evenly mixed, and more prompt in its effects upon the land; and when laid upon it in its hot state, it not only occasions the destruction of weeds, but powerfully stimulates the action of manure. An idea, indeed, generally prevails, in consequence of burning being the mode usually resorted to in the employment of lime, that calcination is necessary to render it fit for use as manure, but this, as we have already remarked, is a mere mistake.

One very strong reason for applying it instantly is, that, if spread immediately after being turned, and while yet in a powdery and caustic state, a smaller quantity may suffice to cover the whole surface of the ground, and to come into contact with more minute particles of the soil; whereas, if suffered to lie for any length of time exposed to the atmosphere, it imbibes so much moisture, that it runs into clods, and can never again be so equally divided into small parts, wherefore a much larger quantity is required to produce the same immediate effect. It is in this state, also, that it acts the most powerfully upon all organic matter which may be already lying undecomposed within the soil—insects, the fibres and roots of obnoxious plants, and the seeds of weeds, which it dissolves and transforms into mould. It is also more efficacious than effete lime in its influence upon what is called *sour land*, though simple chalk, if applied in large quantities, will correct the evil. Neither is it improbable that, during its process of slaking, the heat which it generates by the absorption of moisture causes it to swell in a manner which the tenacity of the soil cannot resist: thus producing fermentation, it not only eventually makes the land mellow, but renders matter which was comparatively inert, nutritive, and is probably more beneficial to land containing much woody fibre, or animal fibrous mat-

* Library of Useful Knowledge: Farmer's Series, No. 18,—Report of a Farm in Ross-shire. Malcolm's Survey of Surrey, Kent, and Sussex, vol. ii. p. 46; Papers of the Bath Society, vol. ii. art. xxviii.

ter, than any calcareous substance in its natural state*. If, therefore, quick-lime really possesses superior qualities as a manure, it seems only fair to infer that, the greater the strength and vigour of such properties, the more assuredly will they effect its purpose when in that state, than after it has been rendered effete.

Considerable judgment is however requisite in this mode of its application; for, although it promotes putrefaction, and converts the pulp, or saponaceous substance, of vegetable matter into the food of plants, yet, if too great a portion of lime be added, it may have a contrary effect; and it always destroys, to a certain extent, the efficacy of animal manures, either by combining with certain of their elements, or by giving to them some new arrangement. It is necessary to the reduction of carrion, or for qualifying the noxious effluvia of night-soil; but is so injurious when mixed with any common dung, that it tends to render the extractive matter insoluble †: thus if a sufficient quantity of quick-lime be added to a heap of stable-dung in a state of fermentation, it will set it on fire, and the whole will be consumed. It should never, therefore, be mixed with farm-yard manure, unless a small quantity be found absolutely necessary for the prompt destruction of seed-weeds, or the decomposition of roots; but when laid upon the land during the same season, the dung should be ploughed down alone, and the lime afterwards harrowed in with the seed-furrow. It may, indeed, be observed, that the dung dropped from horses in their work about kilns is usually so completely destroyed by the lime which falls from the carts in filling, that it is generally found useless to apply it to the land. It also consumes the growing herbage; but, if prudently used, it does not appear to reach the roots, as a fresh verdure soon after arises, and seeds which had previously lain dormant in the soil are brought into action ‡.

By neutralizing the acids combined with the mould, this manure qualifies the vegetable and other soluble substances also present in it, and occasions the whole to be converted, by the influence of the atmosphere and of water, into nutriment for plants; but in poor soils, having less vegetable matter to convert into mucilage, it acts so powerfully as not only to exhaust such land by its final effects, but to be prejudicial to the immediate crops §. We have, indeed, the opinion of a very experienced farmer, who

* In its *first effect*, burnt lime decomposes animal matter, and seems to accelerate its progress to a capacity of affording nutriment to vegetables: gradually, however, the lime is neutralized by carbonic acid, and converted into a substance analogous to chalk; but in this case it more perfectly mixes with the other ingredients of the soil, and is more pervadingly diffused, more finely divided, than mere chalk artificially applied.—Sir Humphry Davy, Elem. of Agric. Chem., lect. vii.

† Sir Humphry Davy, Elem. of Agric. Chem., 4to., p. 280.

‡ A circumstance has been related of mild and quick lime having been separately laid upon land, with the following effect:—the spot upon which the former was laid was soon covered with white clover, but on that on which the latter was left, no vegetation whatever took place for a considerable time, when it at length produced couch-grass, which is accounted for by the hot lime having retained its causticity so long as to have entirely destroyed the seeds of the clover, which are generally diffused in calcareous soils, and consequently flourish through the application of mild lime; while those of the couch were either more difficult to eradicate, or were spread from the adjoining land.—Sinclair's Code of Agric., 3rd edit., note p. 235.

§ 'All the experiments yet made render it probable that the food of plants, as it is taken up from the soil, is imbibed by the extremities of the roots only. Hence, as the extremities of the roots contain no visible opening, we may conclude that the food which they imbibe must be in a state of solution at first; and, in fact, the carbonaceous matter in all active manures is in such a state of combination as to be soluble in water whenever a beneficial effect is obtained.'—Dr. Thomas Thomson's Chemistry, 3rd edit., vol. v. p. 376.

is also well versed in chemistry, 'that, should much rain immediately succeed the ploughing, and any considerable portion of sand be either in the lime or in the soil, it is almost a moral certainty that such soil will be in a worse state than it was before the lime was put on, because, the moisture being retained by the lime and the soil, and the tenacity of the substratum not suffering the superabundance to pass quickly away, it causes the whole to run together, and form a compact and impervious bottom, which before, however, might have been pervious in a slow degree. That this must be the case is evident from this consideration,—that quicklime, mixed with a certain portion of sand, and duly moistened, contracts and forms a substance which we call mortar, or cement; in proportion, therefore, as the quality of these materials is more or less perfect, so does the substance become more or less compact, hard, solid, and impervious: such must be the condition of the soil; and it is but reasonable to suppose that a great part of the seed sown upon it must perish *.'

It may indeed be alleged that the caustic action of quick-lime can never be exerted to any great extent, as it attracts fixed air too strongly not to become immediately slaked; but its effects are found to be powerful even in that short period, provided that it be promptly and intimately mixed with the soil, for though the land should contain an abundance of vegetable matter, yet if it has been injudiciously cropped, or insufficiently manured, the lime will only add to its infertility.

As the dust of quick-lime is prejudicial to health, care should be taken by those who spread it over the land to work upon the windward side. Precaution should also be used, when it is ploughed-in immediately after being spread, to do so when the soil is quite dry, as well also as to prevent the horses from passing through any wet places when going to field; for though the powder of dry lime, when in a caustic state, does not take any apparent effect on the skin, and the hands of a person who has wrought in it are not in the least injured, yet it very soon corrodes the hair and flesh if it has access to water, and horses have been thus irrecoverably lamed. When unharnessed, they should, therefore, be kept dry until thoroughly brushed over, so as to completely remove the dust which may adhere to their coats, and more particularly to their feet and legs. They may thus work without any danger; but, in case of accident happening to either men or horses through being scalded by the lime, the part affected should be immediately washed, either with vinegar or with very sour milk, by which its irritation will be prevented. After the lime has been slaked, it will become effete in about a week, and will then be as little corrosive as any common kind of earth, so that the horses may work among it with entire safety: but if it has been suffered to run into clods before it was spread, these, if not broken into small pieces, will be longer in absorbing a sufficient portion of air, and therefore will remain longer in an acrid state, so that the ploughing will be better deferred for another week, or even longer †.

When quick-lime has been deprived of its causticity, it is called by chemists *carbonate of lime*, and in that mild state it does not act upon animal or vegetable matter with the same violence as quick-lime, but instead of dissipating any portion of the substance which may be contained in the soil, it facilitates its reduction into that state by which it the most effectually assists vegetation. Neither has it the same tendency to combine, as it were into a mortar, with the sand of poor clays.

* Malcolm's Survey of Surrey and the Neighbouring Counties, vol. ii. p. 41—43.

† Anderson's Essays, vol. i. Essay vi. part ii.; Malcolm's Survey of Surrey, Kent, &c., vol. ii. p. 58; Thaër, Principes Raisonnés d'Agriculture, vol. ii. p. 392.

Lime, however, *whether quick or slaked*, when used by itself, without any addition of earth, is not possessed of any vegetative quality: thus, 'seeds planted in a flower-pot filled with powdered carbonate of lime, regularly watered, vegetated feebly, made little progress, and died without coming to perfection; but when partly filled with garden-mould, and carbonate of lime 1½ inch thick over it, the plants put down their radicles straight through the lime, without ramifying or stretching sideways, till they arrived at the mould. Even in a mixture where lime was only one-fifth, the plants were poor and sickly, and made no progress; and when quick, it, with the aid of water, suddenly destroys all vegetable substances*.' It may even be hurtful to vegetation when laid in too large a quantity upon very light and warm soils, for, by quickening evaporation, it dries the land too much, by which means plants are deprived of the moisture necessary to their sustenance; therefore it is that calcareous earths are frequently known by farmers as 'burning soils;' and, by its injudicious use or repetition, without the aid of animal or vegetable manure to supply the nourishment of which they have been deprived by crops, the growth of which has been thus forced, land, though of superior quality, may at length become exhausted †. Thus experience teaches that lime, when applied to land, has different effects upon some soils than it has upon others: on many there is a rapid and permanent improvement, on others there is less benefit, and on some it is said rather to retard than to promote vegetation. This is no doubt chiefly influenced by various unascertained properties in the soil, and partly also by difference in the qualities of the lime itself, arising from its mixture with other earths.

Whether it possesses any further properties, through the stimulating effects of light and heat upon the vegetable fibre, has been conjectured, but has not been supported by any positive fact, and seems to be contradicted by the slow effect of effete lime in its operation upon the soil. It is, however, worthy of remark, that calcareous earth is found in the ashes of all vegetables; that it is present in a larger proportion in wheat, clover, and some other plants whose growth is especially promoted by the use of calcareous manures, and many are said not to ripen in ground in which it is entirely wanting ‡. We may therefore conclude that it is of the highest importance in the process of vegetation, and that an accurate investigation of its mode of action, by enabling us to judge with more certainty of its powers, would greatly tend to the improvement of agriculture. It is indeed much to be regretted that the subject has not been more fully investigated, and that some more definite judgment has not been framed regarding the properties of lime, the effects of which in its application to the soil are exposed to the most contradictory results. Much money has thus been uselessly expended and labour thrown away, which, under better information, might have been saved; and without scientific analyses of the component parts both of soils and of lime, we remain much in the dark regarding their effects on vegetation; but, judging from the faint lights with which we have been furnished, we shall still endeavour, by comparing science with practice, to obtain such instruction as may guide us to an economical and useful application of this manure to field culture.

* Naismith's Essay on Manures in vol. ii. of the Appendix to the General Report of Scotland, chap. xii. p. 89.

† Gyllenborg's Chemical Treatise on Agriculture; Pilkington's Trans., chap. x. sect. viii.

‡ Malcolm's Comp. of Agric., vol. ii. p. 57; Anderson's Essays, vol. i.

APPLICATION OF LIME.

Those purposes appear to be—first, to render whatever substances may be lodged in the soil, or matter which forms part of it, and which may be injurious to vegetation, either harmless or useful; and thus to prepare the soil for the reception and nourishment of seeds and plants: and secondly, to facilitate the decomposition of putrescible matter, so as to furnish food to vegetables during their growth. It has been proved by careful experiment, that the application of lime is the only known alterative which, upon poor, weak, and weeping clays, has power to heal the soil. With the assistance of water, it suddenly decomposes all animal and vegetable bodies, and when thus spread upon neglected ground covered with heath and moss, the old turf is decomposed, and a saponaceous matter is formed which sinks into the soil and covers it with sweet herbage. We also know that it imparts a certain degree of vigour to some peculiar plants,—as, for instance, sainfoin, the roots of which penetrate far into the interstices of chalk, and grow luxuriantly, though only covered by a slight coat of inferior soil *.

It is however an error,—though entertained by many farmers,—to suppose that lime in any state comprises fertilizing properties within itself; and that, without operating upon the soil, or upon the substances which it contains, it is an enriching manure. It does not possess any fertilizing principle in its own composition: it is merely a calcareous earth combined with fixed air, and holding a medium between sand and clay which, in some measure, remedies the deficiencies of both. But though, when alone, unfavourable to the growth of plants, yet experience shows that it is an ingredient in soils which, whether naturally forming a component part of their substance, or judiciously mixed with them by the husbandman, adds greatly to their fertility, for it has the power of attracting much both from the earth and from the air, which occasions the decomposition of plants, and thus converting them into nutriment, it gives power as to vegetation which, without its operation, would otherwise lie dormant. It also appears to act with great force upon that substance which, being already converted by the decomposition of plants into a species of earth, we call *mould* †.

The other causes with which we are acquainted regarding the operation of lime as a manure would lead to a chemical discussion, which could only prove uninteresting to the generality of our readers; we shall therefore confine ourselves to the following observations.—There can be no doubt that it is a most powerful stimulant when applied to deep loams and heavy clays, which contain mould of a nature so sour as to appear to unfit them for the purposes of vegetation; or to land which has been previously either more or less manured with animal or vegetable substances, without any addition of lime or other calcareous matter, in which case it often produces effects far more fertilizing than the application of dung, for its active powers render every particle of the putrescent manure useful; but if the latter be not afterwards repeated at no great distance of time, the soil will, in the course of a few years, become considerably exhausted. In all arable land, however impoverished it may be, either by nature or bad manage-

* See Naismith's Elements of Agriculture, p. 334. Thaër, Principes Raisonnés d'Agriculture, 2nde edit., tome ii. p. 387; and Anderson's Essays, No. vi., part 2, Aphorism iv., in which it is stated, that calcareous matters act as powerfully upon land that is naturally poor, as upon land that is more richly impregnated with those substances which tend to produce a luxuriant vegetation.

† Respecting the formation of mould, see the chapter on Soils.

ment, there yet always exists some portion of mould, and, on this, a first dressing of lime occasions a sensible improvement of the soil, which soon becomes apparent in the increased product of the crops. A second dressing will also be attended with some apparently good effect; but unless that, and every succeeding repetition, be accompanied with ample additions of farm-yard manure, or other putrescent matter, to supply the loss thus occasioned by the exhaustion of the vegetative power, every future crop will be diminished. The land is then necessarily thrown out of cultivation, and left for a series of years to recover itself under pasture, which, in the course of time, may be effected according to its former condition; but in the interim it is rendered nearly fruitless. It is thus that many thousands of acres in every part of the kingdom have been run to a state of almost total infertility; and it is even said, that the too great use of lime, though apparently judiciously employed by some of the first farmers in the Lothians, has been lately found very detrimental to their crops.

Marsh lands, however, which have been drained, will generally support a repeated and abundant application of lime, because they usually contain a large proportion of matter upon which the stimulating powers of lime are peculiarly adapted to act; and it will be found much better suited to the purpose than dung. On all rich, deep, dry, and loamy soils it may also be applied with effect; for although they contain within themselves the component parts of the best soils, yet they are frequently found to be sluggish and inert; and dung, whether through imperfect fermentation or owing to the want of calcareous matter, often remains dormant in the land until roused by moderate quantities of quick-lime, which, if applied at distant periods, will effectually operate to bring it into activity. It should, however, be turned into the ground some weeks before the dung, in order that it may become thoroughly slaked by mixture with the soil, or otherwise it would have the effect of abstracting some of its nutriment. Such soils, after the application of lime, produce much heavier crops with a much smaller proportion of dung than if no lime had been used, because the operation of the latter acting upon the dung renders every portion of it useful.

Clay land shows an evident disposition to combine with lime, and it bears the repetition of this species of amelioration better than lighter soils. When applied to heavy tillage land, either for the purpose of reducing its cohesive properties, or of supplying an additional quantity of calcareous matter, small dressings of lime will have but little effect; and if sand or calcareous earths are to be employed, it is recommended, by a practical farmer of known experience, as more economical to apply them separately than as a compost*. It powerfully assists all adhesive soils; and when laid hot from the kiln upon deep clay, it has been known to occasion a very large increase in the former crops. It has also been often observed, in fallowing clayey soils, 'that, in wet weather, when a dose of lime has been just given, the land continues more friable, and is less apt to bind up on the recurrence of drought, than where it has been neglected. The grain growing on the well-limed ground preserves its healthy appearance in wet seasons, while that growing on land that has not been limed is yellow and sickly †.'

Upon *sandy soils*, which seldom abound much in vegetable matter, lime has a mechanical operation, which, by combining with the finer particles of

* Russell's Practical and Chemical Agriculture, p. 176.

† Library of Useful Knowledge, Farmer's Series, No. 12, Report of a Farm at Kyle, in Ayrshire.

the soil, gives consistence to the staple of the land, and attracting the moisture from the atmosphere, it imparts it so gradually as to be less liable to be hurt by drought in those parching seasons by which crops are injured. It is therefore said to be cooling to hot land; but if it be not also mixed with some portion of clay, with which it may combine, it then is apt to unite itself with the sand, with which it composes a kind of mortar, the effect of which has been already described, and which cannot be dissolved without much difficulty, and the plough often brings hard lumps to the surface of the soil which cannot be easily broken. Thus when such land has been frequently limed, nothing can restore it but the abundant and reiterated application of putrescent manure; the demonstration of which is perceptible throughout many parts of England, where, from possessing a chalky soil without strength to maintain a sufficiency of live stock to furnish dung, the land has in many places been worn out through the inconsiderate use of lime.

On the *exhaustion of land by the application of lime* there is, however, much difference of opinion. It is indeed evident that the continuation of cropping, without an addition of nutritive manure, will ultimately exhaust the best soils; but though their natural fertility be thus aided, it yet cannot depend entirely on that support. This must be apparent if we reflect that land, without any addition of animal or vegetable substance, will still produce crops: for pure sand, clay, and chalk, though each in themselves separately barren, yet, when mixed together, exert chemical influences upon each other, which, by the attraction of the air, the dews, and the rain, the force of the sun, and the generative powers of growing vegetables, effect the production of corn and fruit. It is therefore clear that the land alone is capable of vegetation; but every day's experience proves, that the amount of its products, its fertility, in short, depends in a great degree upon the decomposition of the substances which have been previously converted into vegetable mould, or which are added to it by manure. Anything whatever may be called manure which, when applied to the soil, either rectifies its mechanical defects, corrects any bad quality, and either stimulates it to yield, or stores it with nutriment. Thus, if lime be laid upon pure sand, although the latter would be rendered more tenacious, and would thereby become more favourable to the germination of vegetables, yet seeds could find no nourishment from either the lime or the sand, and putrescent manure would still be necessary to produce a crop. But if the soil consist of clay and sand, containing animal or vegetable matter in a torpid state of decay, then lime would be preferable to dung. The state of the soil should therefore be minutely inquired into before lime is employed, and it should be only used to give effect to the inert substances with which it may be combined *.

By the analysis of soils, we find that all productive earth contains a certain portion of lime; and although we learn from experience that its stimulative powers upon the roots of plants are very great, yet we are but imperfectly acquainted with the extent or the exact manner in which its influence is brought into action, and 'we are in a great measure ignorant of the actual changes that are produced upon the earth after this manure has been applied †.' It would, however, seem, that, where it exhausts, it is only by hastening the putrefaction of the animal and vegetable matter in the soil, and by that means applying a larger portion of those substances

* Finlayson's Practical Essays on Agriculture, 2d edit., p. 111; Bland on the Principles of Agriculture, chap. iv.

† Anderson's Essays on Agriculture, 4th edit. vol. i. p. 525.

in a given time than could be otherwise afforded to the growth of plants. It is thus known to produce more luxuriant crops, and it will also consequently enable the farmer to continue his land in tillage,* during a certain time, with more effect than if no calcareous manure had been laid on; but, although it may not tend to the deterioration of the original staple of the soil, it can hardly be doubted that it must be thus more promptly deprived of its fertility than if the exhaustion of that vegetable mould with which it had been supplied by nutritive manure were occasioned by a more gradual process of decomposition.

That this is the only way in which effete lime can exhaust land, seems probable from the large quantities of neutralized calcareous earth which are often applied without any bad effect in the form of chalk, shells, limestone-gravel, and the whole tribe of marls. A larger quantity of these is oftener laid on in one year than would be used of lime in half a century, were the land in tillage to be managed according to the custom of some countries; yet it is not generally impoverished, and, in many cases, it is permanently improved. This, however, is probably occasioned by its combination with other substances, which either counteract its exhausting powers or supply the waste of nutritive matter. It must, however, be admitted, that this is not apparent in regard to chalk, which is commonly applied in large quantities without any bad effects, and there are many instances of soils more naturally fertile than perhaps any others that are known, and which seem to consist almost wholly of calcareous earth*; but were their properties critically analyzed, it is still possible that they might be found essentially different from those which they are commonly supposed to possess.

A very eminent writer on agriculture, when treating of stimulant manures, which are generally supposed to be only of use when applied to rich soils, and when applied to poor land would produce hardly any, or even hurtful effects, says, in contradiction to that theory,—that 'he is firmly convinced, from repeated observations, that lime and other calcareous manures produce a much greater *proportional* improvement upon poor soils than on such as are richer: and that lime alone upon a poor soil will, in many cases, produce a much greater and more lasting degree of fertility than dung alone†.' That, however, does not throw any doubt on the assertion, that it acts with as great *proportionate* power upon land that is naturally poor, as upon that which is more fully impregnated with those substances which tend to promote a luxuriant vegetation; but we believe that the experience of farmers will prove that its application to poor land, and especially to that which has been previously limed, if it does not eventually tend to its complete exhaustion, will at least never be found to repay the expense.

The employment of lime seems to be of the greatest service in the *breaking up of fresh and coarse land*, on which it acts more powerfully than on soil which has been long in cultivation, and indeed the most striking improvements have been effected by its means on moorlands and mountain; but it should be given for the first time abundantly. Such is the usual effect of lime upon arable: upon *grass-land* it is laid in smaller quantities; and in this top-dressing, perhaps the preferable mode is to apply it in a compost with earth; except when the soil consists of clay. When thus spread upon the surface, its action upon the sward is pro-

* Malcolm on the Agriculture of Surrey, Kent, and Sussex, vol. ii. p. 55. Marshall's Midland Counties, vol. ii. Minute 100

† Anderson's Essays on Agriculture, vol. i. p. 569.

ductive of the most palpable improvement, and continues perceptible during a long period. No other manure will create so rapid a change; for it is such an excellent corrector of acidity, that it tends to produce the sweetest herbage where only the most unpalatable pasture was formerly to be found. This, indeed, is so apparent, that if a handful of lime be thrown upon a tuft of rank, sour grass, which has in former years been invariably refused by cattle, they will afterwards eat it close down. Now, animal dung, when dropped upon coarse benty sward, produces little or no improvement until limed; it then, however, not only augments the crops, but the finer grasses continue in possession of the soil, and the land is thus doubly benefited; for the dung dropped by the stock on which it is pastured, is both increased in quantity, and improved in quality *. Farmers should never consider lime as the food or nourishment of plants, but as an alterative of the soil; never to be used but when nature requires it, either to dissolve noxious combinations, and to form new ones; to bind loose soils, or to diminish excessive cohesion; and to reduce the inactive vegetable fibre into a fertile mould. For such purposes there is not, perhaps, a more valuable article in the whole catalogue of agricultural remedies; but some farmers, who do not reflect upon the subject, when they perceive that lime has once excited the dormant powers of the soil into action, and that good crops succeed for a few years, are apt to draw from thence very false conclusions, and continue liming and tilling without the assistance of putrescent manure, until their land at length is rendered incapable of the production of corn. It has indeed been pertinently observed by a good judge of such matters, 'that there is an analogy between the treatment suitable to the animal and vegetable creation. When medicines have removed the cause of their application, they are discontinued, and the patient, rendered weaker by the application, requires some invigorating aliment: in like manner, some time after an effectual liming, the soluble carbon of the rotten dung, or some such restorative, should be applied to the soil to replenish it with what it may have been robbed of by the action of the lime †.'

In fine, lime should always precede putrescent manures when breaking up old leys for cultivation, for, if the land contains acids, or noxious matter that is poisonous to plants, they will be decomposed and rendered fit for vegetation; and hence the superiority of lime to dung on new lands. But calcareous and putrescent manures operate very differently: 'the former, being more stimulant and corrective, help the farmer to an abundant crop at the expense of the soil alone; while the latter furnish the land at once with fertilizing fluids, and will insure a good crop on a place perfectly barren before, and after the application of lime ‡.'

Much uncertainty prevails among farmers *regarding the state of lime*: some contending that it should only be applied when hot and powdered, and that when it has been slaked, its effect is comparatively trifling; others maintain the contrary. But these disputants consist chiefly of men whose experience has either been confined to one kind of soil, or who have only used it under particular circumstances, and as they only condemn the system of others because their own has turned out successful, or the reverse, it is

* In Derbyshire the farmers have found that, by spreading lime in considerable quantities upon the surface of their heathy moors, after a few times the heath disappears, and the whole surface becomes covered with a fine pile of grass, consisting of white clover and the other valuable sorts of pasture-grasses.—Anderson's Essays, 4th edit., vol. i. p. 527. Survey of Derby, vol. ii. p. 437; and of Westmoreland, p. 235.

† Walter Davis, Survey of North Wales, p. 303.

‡ Finlayson's Practical Essays on Agriculture, 2nd edit., p. 112.

not improbable that, in the view they take of the subject, each may be in the right. It will therefore probably be found, that in all cases where the land is constitutionally disposed to receive benefit from a calcareous dressing, that is to say, when it has not been previously limed, or when it has been long laid down and refreshed by grass, or enriched by the application of dung, it is of little importance whether the operation take place when the lime is quick or effete. Upon waste lands, however, its causticity has an evident and necessary effect; for the undecayed vegetables, which abound in all soils in a state of nature, should be speedily decomposed, and it should therefore be spread hot from the kiln. In point of economy, too, there can be no doubt but that it is most thriftily used when laid upon the land in the latter state: for the labour is less; and a smaller quantity will serve the immediate purpose. It is, however, obvious that the choice of circumstances and season is not always in the farmer's power; and that necessity often obliges him to lay it on when completely effete. It has been said, indeed, upon high authority, that caustic lime exhausts the land; but repeated trials have shown that its ultimate effects are equally beneficial in the one state or the other, though there is a more immediate advantage in the employment of quick-lime by the destruction of weeds. A common method is to leave it spread during some months upon clover or sainfoin, not intended to be broken up until the following year,—a plan which is advisable with regard to marl, which partakes of some of the qualities of lime, and is the better if allowed to remain during a season exposed to the atmosphere; but the stimulating properties of quick-lime will be thereby lost, as it will be converted into mere chalk. Opinions are also much divided respecting its effects when laid upon pasture land which is intended to be kept in grass. There is indeed no question that, in either state, if applied in moderate quantities to a dry soil, or to land that has been completely drained, such a top-dressing will have the most beneficial effect upon the herbage; but it must be admitted, that when laid on quick, it requires more circumspection in its application, and should not be employed in the same quantity as when effete*

We learn, from the General Report of Scotland, that there, 'in the best-cultivated counties, lime is now most generally laid on finely-pulverized land, while under a fallow, or immediately after being sown with turnips. In the latter case, the lime is uniformly mild: in the former, quick-lime, as pernicious (in a certain extent) to vegetation, may be beneficial in destroying weeds; and some experiments have been recorded, showing it to have a very powerful effect upon the fly, to which we shall find future occasion to advert. Sometimes mild lime is applied in the spring to land, and harrowed in with grass-seeds, instead of being covered with the plough; and under this management a minute quantity has produced a striking and permanent improvement in some of the hill-pastures of the south-eastern counties. Its effects are yet perspicuous, after the lapse of nearly half a century. In some places lime is spread on grass-land a year or more before it is brought under the plough, by which the pasture in the first instance, and the cultivated crops subsequently, are found to be greatly benefited. But in whatever manner this powerful stimulant is applied, the soil should never be afterwards exhausted by a succession of grain-bearing crops—a justly-exploded practice, which has reduced some naturally fertile tracts to a state of almost irremediable sterility.'

* Essay on Manures, by Arthur Young, in the Papers of the Bath Agricultural Society, vol. x. p. 119. Farmer's Magazine, vol. iii. p. 77. Thaër, Principes Raisonnés d'Agriculture, 2de edit., tom. ii pp. 388 399.

To point out the precise effects of lime, and the proper quantity to be applied, to the extent to which it has been already ascertained, would greatly exceed the limits of this publication; and were it possible to define its powers upon every gradation of soil, a series of experiments would be required which would occupy the labour of a long life. Its qualities, too, differ materially in various places, from the greater or less quantities of extraneous substances with which it is combined. It is very rarely that any farmer can obtain a choice of lime, and when only one species can be procured he must be content with it; but he may, nevertheless, be benefited by the following observations.

QUALITIES AND QUANTITY OF LIME

Pure lime-stone, or *chalk*, when fully calcined, is reduced to a fine impalpable powder, that feels soft within the fingers without the smallest tendency to grittiness: but such lime as contains sand is neither so soft nor fine, but feels more or less gritty in proportion as the sand is coarser or finer, and more or less in proportion. Commonly, the whitest lime is the best; when perfectly calcined, it is generally of a bright white, without any shade of colour, and if clouded, it is thought to proceed from a mixture of other matter; but the colour is not an infallible criterion, for dark-coloured lime has, in some few instances, been found stronger than that which was perfectly white. The purer and the stronger the lime is, the lighter also it will be found when weighed. Hence it follows, that the best lime for the farmer's use is that which is the softest to the touch, the whitest, and the lightest.

The other simple tests for ascertaining its quality, which will be found sufficient to decide upon the comparative value of any two kinds of lime, and may be relied upon as sufficiently accurate for the common purposes of the farmer, are as follows:—If the limestone loses much of its weight in calcination, and the lime-shells are extremely light;—if the shells require a very large proportion of water to slake them fully;—if it is long before they begin to fall;—if the limestone is not apt to *run* (or to become vitrified) in the operation of burning;—if it falls entirely when it gets a sufficient quantity of water, after it has been properly calcined;—if it swells very much in slaking, and if the lime is light, fine to the touch, and of a pure white—he may be satisfied that it is extremely good, and he may use it in preference to other lime that is inferior to it in any of these respects. The presence of lime may also be discovered by its effervescence, or ebullition, on being exposed to common vinegar*.

When quick-lime, too, is completely sifted through a fine hair-cloth, that is the strongest which leaves upon the cloth specifically the smallest of earthy or sandy particles; and that, also, of which the smallest quantity, when spread upon the same space of ground in soils of equal quality, will the soonest burn up the surface of the grass. We may also add, upon the authority of Sir Humphry Davy, that lime, when slaked with sea-water, has been used in some cases with considerably more benefit than when wetted in the common manner.

The benefit which might be derived from the union of a slight portion

* More detailed information on the mode of pursuing experiments on lime may be obtained from Anderson's Essays, Essay vi. part ii. sect. 11, 12, and 13, p. 88, from the substance of which the foregoing is chiefly extracted. Our farming readers will also find an ample discussion regarding the analysis of lime, in the following volumes of the Farmer's Magazine, v. pp. 27, 265, 451; vi. pp. 11, 192, 312, 316; vii. pp. 26, 33, and in Sir Humphry Davy's 7th lecture.

of chemical skill with agricultural knowledge is perhaps incalculable. The present state of education among the generality of farmers is not such, however, as to enable them to reap much advantage from scientific experiments, and even chemists rarely have opportunities of applying their art to practical purposes of this kind. It may, however, prove useful to some to offer a few brief directions for the analysis of lime, which we extract from the recent work of Dr. Henry:—

'To determine the purity of lime, let a given weight be dissolved in diluted muriatic acid. Let a little excess of acid be added, that no portion may remain undissolved owing to the deficiency of the solvent. Dilute with distilled water; let the insoluble part, if any, subside, and the clear liquor be decanted. Wash the sediment with further portions of water, and pour it upon a filter, previously weighed. Dry the filter, and ascertain its increase of weight, which will indicate how much insoluble matter the quantity of lime submitted to experiment contained. It is easy to judge, by the external qualities of the insoluble portion, whether argillaceous earth abounds in its composition *.'

The presence of *magnesia* in limestone has been considered pernicious to vegetation when burnt into lime. It had been long known to farmers in the neighbourhood of Doncaster, and other parts of Yorkshire, Derby, and Nottingham, that lime made from a peculiar species of limestone injured their crops; and that made from the Breedon limestone, in Leicestershire, which there goes under the denomination of 'hot lime,' is so powerful, that it is there seldom used in larger quantities than from 25 to 30 bushels an acre, unless the land be very rich. A series of experiments were made upon the former by Mr. Tennant, who discovered that it contained magnesia, and on mixing some calcined pure magnesia with earth, in which he sowed different kinds of seeds, he found that they either died or vegetated very imperfectly; he therefore came to the conclusion that its effects were prejudicial. This is thought to have been occasioned by its retaining its caustic quality longer than pure lime; and that, if used to excess, it has a poisonous effect on vegetables, though, 'on poor soils,' it has been said 'neither to receive water so rapidly, nor to part with it so freely, as lime; and in this respect it seems to hold an intermediate property between lime and clay †.' Experiments have also been made by Sir Humphry Davy and other chemists, from which it may be collected that, although, when calcined, as lime, it may become pernicious to land, if laid on in too large quantities, yet that, in its mild state, it is a useful constituent of soils. One of the most fertile parts of Cornwall, in the neighbourhood of the Lizard, is a district in which the land abounds in magnesian earth. It is, indeed, one of the mildest absorbênts with which we are acquainted, and upon ground which is infested with sorrel, its application is an immediate remedy. Magnesian limestone is usually of a pale yellow or brown colour, and is found in many parts of England‡, as well as Ireland: it effervesces when plunged in acid, though it only dissolves slowly.

Its analysis requires a process too tedious to be here stated, but its existence in lime, in a pure state, may be ascertained by the following test:—

Having taken out all the mineral oxide, next pour into the fluid a solution of neutralized carbonate of potassa, continuing to do so until it will effervesce no longer, and till both the test and smell of the mixture indicate an excess of alkaline salt. The precipitate that falls down is carbonate of lime: it must be collected on the filter, and dried at a heat below that of redness.

* Elements of Experimental Chemistry, 10th edit., vol. ii. chap. xv. sect. iii.

† Russell's Practical and Chemical Agriculture, p. 37.

‡ See Phillips's Geology of England and Wales, p. 30.

operation may have been ineffectually performed. Although specifically lighter than any soil, it is, however, very commonly left in small lumps, which then fall into the bottom of the open furrow when the land is ploughed, and there remaining below the staple of the land, it naturally becomes useless for the purposes of the farmer: the operation therefore demands the most minute attention. When the lime, which may have been spread upon the ground, has been either already ploughed under, or only harrowed in, or both, it should be again harrowed and afterwards ploughed in. This must, however, be done as superficially as possible, in order to avoid burying the lime; and perhaps the best implement for that purpose is a scarifier, or one of the many scufflers now in use, as they mix the lime with the soil more effectually than can be done by the plough. The land must then be again harrowed and ploughed; but still not to a great depth; and in this manner it should get at least three ploughings and harrowings, if the soil be light, and four, or even five, according to the condition of the land, if it should be heavy: but, we repeat, that in no case should the lime be suffered to sink deep into the ground. We have indeed, on this, the evidence of Mr. Dawson, of Frogden, which, after the experience of upwards of half a century, is too well known and too highly appreciated to admit of doubt, that in every instance, upon his own land, in which lime was only harrowed in, when laid up for pasture, the ground not only continued, for upwards of thirty years, to produce the fine grasses, but, when ploughed down, those parts of the soil which were not sufficiently mixed with lime, though sown with clover, became gradually covered with bent; and he also adds his testimony, that, when properly mixed with lime, the effects of dung are not only greater, but much more permanent, whether under tillage or pasture*. It should, however, be observed, that the depth of the ploughing may also be made to depend, in a great degree, upon the quantity of lime that is used as well as upon the state of the soil; for not only is a less portion of calcareous manure requisite upon sands than upon clays, but as it sooner sinks into the former than into the latter, and the object is to keep a sufficient quantity mixed with the surface, it cannot, in that case, be ploughed with too shallow a furrow.

This renders a clear and well-wrought fallow absolutely necessary; but in this manner, if the lime be laid in the full quantity upon the proper soil, and if the future cultivation and manuring with putrescent matter be in all respects carefully conducted, it will produce the expected effect upon the land, the amelioration of which will last for a long series of years. This mode of application is approved by the most enlightened farmers; yet there are many who affirm that grass-land forms the best bed for the reception of lime. When grass-land is broken up, it is however very generally full of weeds, which nothing but a complete summer fallow can thoroughly conquer; but if the land be clean, and the lime can be got forward in time, the application may in many cases prove successful.

Amongst numberless accounts of the effects of lime upon a variety of soils, we extract the following minute details of a series of experiments carried on during a period of twenty years upon a large farm in the north by a most intelligent man, the accuracy of whose statement appears to be entitled to the most entire confidence, and from which, if attentively considered, some useful information may be gleaned. The several fields thus operated upon were—

No. 1.—Soil composed chiefly of thin clay, some of it mixed with

* Letter from Mr. Dawson to the Editor of the Farmer's Magazine, vol. xiii. p. 60.

peat, and the whole incumbent upon a subsoil retentive of moisture: it had been in grass for several years, but yielded very poor returns.

The mode of cultivation pursued was this. The land was fallowed without taking any corn crop, and the lime was applied in a perfectly effete state during the following spring, at the rate of 220 bushels per imperial acre. The crop was oats: but little benefit was discovered from the lime until the following year, when the soil began to ferment, which showed that the lime was then in action. It was then sown with flax, the crop of which, both in flax and seed, was excellent. This was followed by peas, which returned a great bulk of haulm, but not much grain: the clay part of the land was now, however, quite loose and free, while the peat seemed more compact and firm. The field was then sown with red wheat, which turned out a very fine crop; and although it was not dunged until the ninth year, when it was thoroughly summer fallowed, the other crops continued good until it was laid down at the end of twelve years to pasture. Since that time it has been a few years under corn; and though the produce of these crops cannot by any exertion be made to equal those preceding, yet the soil has been evidently much improved in every respect, when compared with its original state previous to the lime being applied.

No. 2.—This field, of nearly the same thin clay as the former, had been ill-treated by the preceding tenant, and was in a very exhausted state, though it is not stated that it had been previously limed. After being summer fallowed, it was laid down to pasture during several years; after which lime was applied to the sward during the winter months, and in the February following it was sown with oats. The crop was only middling, and in the six subsequent years it did not appear that much benefit was gained by the application. In the eighth year, however, the lime acted vigorously; a small part of the field, which had been left unlimed, being at least 50 per cent. inferior in crop, though the management was in every respect similar. It may perhaps be difficult to account for this cessation of action in the lime during this long period, though instances of a like nature are not unfrequent upon inferior soils: but it appears, from the statement of the cultivation, that a deeper ploughing had been given in the preceding season, by which, no doubt, the lime was brought to the surface; and having besides been assisted by a copious application of dung, there can be little question that the difference between the crops was occasioned by the stimulus which was thus applied to the manure.

No. 3.—A real moorish soil, incumbent upon a close bottom which had been over-cropped, after lime, by a former tenant. This field was summer-fallowed, and limed with effete lime at the rate of 160 bushels per imperial acre. Oats were then sown; but the crop was poor, and after-attempts were not more successful. The stalk of the plant generally *singed* and decayed, after the strength of the seed-pickle was gone.

No. 4.—Of a similar soil, but rather superior in quality to the former. Was fallowed out of grass, and the lime was applied hot from the kiln; but the effects were the same as those mentioned in the preceding instance. The oat-crop looked brisk at first, but decayed daily; and though dung was tried with a second fallow, and appeared to operate in a slight degree, it yet did not repay the cost incurred. These two trials, which appear to have been very fairly

made, clearly prove that land which is either poor in itself, or which has been worn out by the previous use of lime, will not pay the expense of a further application.

No. 5.—The soil of this field was a soft loam upon a wet bottom, which, though it did not appear to have been limed, yet was in a very exhausted state. It was therefore summer-fallowed after a crop of wheat, and quick-lime was laid upon it at the rate of nearly 200 bushels per imperial acre. This operated immediately; and at the expiration of sixteen years, during which time the land has been only three years in grass, its effects had not then ceased.

No. 6.—Was a strong loam, incumbent on clay, which had consecutively carried five crops of grain after being ploughed from old grass. This field was dunged, as well as summer-fallowed; quick-lime was also laid on at the same rate as on the preceding, in the month of August, after which six ploughings were given. This, in less than a month, occasioned a fermentation of the soil, 'something similar to what is produced by yeast upon unbaked bread.' In one respect, the improvement made upon this field by the lime was conspicuous: barley could with difficulty be raised upon it previous to its application, but afterwards fine crops of that grain were produced, and the ground was tilled with much greater facility than formerly, which is itself a sure token of amelioration in the soil.

No. 7.—Consisted of a heavy deep loam; some of it a strong, tenacious, red clay, but almost wholly incumbent upon a close bottom. It was ploughed from old grass, and sown with oats; was summer-fallowed in the ensuing year, and dressed with lime, which was mostly applied hot from the kiln, being drawn from the cart in regular-sized heaps of 5 pecks each, or thereabouts, and spread the moment it was slaked by rain or atmospherical moisture. About two-thirds of the field received 240 bushels per imperial acre, the remainder from about 280 to 340 bushels per acre. The whole answered well, and the entire operation appeared to be in direct proportion to the quantity applied; nor was there any distinction discernible in the effect of that which was laid on hot, though, as the season was remarkably wet, some of it was nearly in the state of mortar, and that there appeared an evident inferiority on some ridges on which quicklime had been spread in a windy day, which probably occasioned some of it to be carried off.

No. 8.—Was also chiefly loam, though of different qualities, and mostly incumbent upon a close bottom. This field, which consisted of 50 acres, had been cropped from time immemorial, and was so tired of carrying wheat, that it seemed scarcely worth ploughing. It was therefore laid down to grass by the in-coming tenant, and remained in that state during five years, when it was again broken up. Only 30 acres were limed, and this was laid upon the sward at the rate of nearly 160 bushels per imperial acre: but some of it was laid on three years before ploughing, some two years, and the remainder only a few days before the plough entered—part of it hot, and the remainder effete. No experiment could therefore have been better calculated to ascertain the different effects of lime upon the soil; yet throughout the whole field, even in the first year, they were nearly the same; the crop was equally abundant wherever the lime had been applied, but strikingly inferior upon the 20 acres on which it had been omitted.

This would show that the application of lime to grass-land one or two years before it is broken up, as inculcated by several writers upon husban-

dry, is neither necessary to the soil, nor reconcilable with economy; as in case of any declivity in the ground, much of the lime is washed off the surface by the rains, and lost before the land can be ploughed. It also proves that, in the trials just recorded, as well as in others upon the same farm, though not here mentioned, there was no visible difference between the application of quick-lime and that which was effete: added to which, there is this remarkable fact—'that much difference of opinion having prevailed relative to the quality of the limestone-quarries in the neighbourhood, a trial was made of the lime from each of them upon six adjoining ridges of one of the fields—numbered 7. Though a difference to the eye was visible in almost every one of those samples, yet the effect upon the ground was in all of them precisely similar, nor could the most accurate judge say which was best. The quantity applied was in each case the same; and the operations of laying on the lime, spreading it, and ploughing the ground, were all carried on in a uniform manner*.'

On the best consideration which we can apply to this important subject, we should say—Let the farmer, as a primary ground for determination, well weigh the nature and the condition of his land, as well as the amount of the cost, previous to the application of a dressing of lime. If it is to be broken up from grass which has lain long in pasture, and without having been previously limed, and that he can afford the expense, let him lay on a round quantity at once; for if it be intended as a permanent alterative—a corrective and amendment of the properties of the soil,—it should get a full dose, and anything short of that will be found little better than money thrown away. But if it is to be applied to ground that has been under tillage, and upon which lime has been previously laid, it can then only be used with advantage after a series of years have elapsed, and in small quantities; upon land also which has been kept under a proper rotation of husbandry, and has been regularly manured with stable-dung, bones, rape-dust, or other nutritious substances, upon which it may exert itself, as it will merely give increased effect to the riches which may have been thus added to the soil by superior management. In such cases, however, it may be usefully employed after every second or third dunging; for whether it be owing to an imperfect fermentation, or to whatever cause, it is certain that a portion of all the dung which is laid upon ground remains nearly in a dormant state until forced into activity by the application of some alkaline or calcareous matter.

On all land it decomposes nutritive matter, which may be supposed to lie otherwise in an inert or apparently insoluble state: it is advantageous on sands, because, so long as it remains well mixed with the soil, it attracts moisture from the air, which prevents them from burning; and if applied to clays, or other deep soils on which no calcareous manure has been previously laid, it renders them less cohesive, and more easily penetrable by vegetable fibres †. On calcareous soils it necessarily has but little effect, because it there already forms a part of the matter of which

* Those who may wish for further details regarding these experiments are referred to the third volume of the Farmer's Magazine, pp. 77, 325. The numbers in this account are not however placed in the same order as that statement, but are classed according to the particular nature of the soils.

† Thus, among numberless instances of its effects upon land of the latter description, one is mentioned, in an account lately published of a farm in Ross-shire, which, under former management, produced such scanty crops of oats, that they scarcely paid the expense of cutting; yet in the following year, the same ground—having had 200 bushels of lime applied for the first time, together with 12 tons of farm yard manure—yielded at the rate of 40 bushels of wheat per acre. This might, indeed, have been

they are composed; but when laid on grass-land as a top dressing, it has greatly improved every species of soil, and has promoted the growth of the finer grasses; thus adding to the luxuriance of the herbage, and augmenting the productive powers of the soil when afterwards ploughed for grain *. As lime, however,—notwithstanding the fact which has been just recorded regarding the similarity of its effects,—whether mild or quick—yet differs materially in its strength, inquiry should always be made on that point previous to its application. The following general rules may be taken as a summary of what has been already stated.

1st. Before the application of lime, the land should be thoroughly drained and laid dry.

2ndly. It may be carried on whenever the teams are the most at leisure; but summer is the best season, and it never should be laid upon the land unless in dry weather.

3rdly. It should be laid on while in a powdery state—the drier the better—and kept as near the surface as possible, as then best adapted to mix intimately with the soil.

4thly. It may be applied either quick or effete; but if in the former state, it will have more effect in the cleansing of the land, and a less quantity will serve the immediate purpose. It should, however, be carted upon the land as soon as possible, and spread directly before the plough, letting that follow so quickly, as that the body of the lime shall be slaked in the soil; and it must be cautiously applied to light soils.

5thly. As it has a tendency to sink into the ground, and it is important to preserve it near the surface, it should be ploughed with a shallow furrow.

6thly. When found, after a few years, in lumps, and much below the surface of the land, it should be ploughed up and repeatedly harrowed, so as to ensure its intermixture.

7thly. Clays and strong loams require a full dose; but for sands and other light soils, chalk, or a much less quantity of lime, will serve—each in proportion to the strength of the lime and of the land.

8thly. If the land be not supplied with the same quantity of putrescent manure that is usually laid upon other soils, the crops will suffer; and if it be not then laid down to grass for a long series of years, it will be worn out and exhausted.

LIME KILNS.

The calcination of lime is an operation so generally understood in every part of the country where it is commonly found, that it scarcely requires to be described. Its effective burning is however a point of some difficulty, and the construction of kilns has occasioned much discussion. They possess various degrees of merits, but their description would occupy more space than can be afforded to the subject in the limits of this publication. We however extract the account of one designed several years ago by the late Bishop of Clogher,—or, as other accounts say, by Mr. Rawson, of

ascribed to the dung, as well as to improved culture, but another field, of the same kind of land, produced 36 bushels, solely with the application of lime, without any dung.—Library of Useful Knowledge, Farmer's Series, No. 18, p. 91.

* Calcareous soils have also been found to possess the advantage of guarding the sheep which graze upon them from the rot; and there can be no doubt that the application of lime, if accompanied by proper drainage, will materially assist in producing properties of corresponding efficacy. It is likewise known to be a great preventive, when lain upon pasture-land, of that destructive disease the foot-rot.

Cardington, in the county of Kildare*,—which has since extended to several other parts of Ireland, where it has been found of the most essential service in the improvement of the moors and bogs, and is so simple as to deserve to be more generally known.

It is partly an inverted cone, and partly a cylinder, of which the annexed cut will afford an elevation.

The dimensions of the conical part are 8 feet high, and the diameter at bottom about 18 inches; the cylindrical part of the same height as the cone; making altogether 16 feet; though it is observed by the reporter that 20 feet in height—namely, 11 for the cylinder and 9 for the cone—would be preferable. The diameter of the cylinder, and of course also the largest diameter of the cone, is 8 feet. The kiln is to be fed through an iron door, and, when filled, should be shut close: a metal plate with holes, or a close grating, is placed at the bottom to give air to the fire, and two flues should be carried through the wall at about 8 feet from the eye of the kiln, in order to add to its force. It is also recommended that an outside wall be slightly raised at such a distance as that about a couple of feet of yellow clay may be closely packed between it and the inner one, as a precaution against its splitting, and the fire thus becoming exhausted. The fuel used is turf, and, when well attended by a couple of men and a boy, will turn out about 50 barrels of roche-lime in the twenty-four hours †. This kiln, together with

* Surveys of Tyrone, p. 113; and of Cavan, p. 68. See also a Prize Essay on the Construction of Lime-kilns, by Mr. Menteath, of Closeburn, in the Transactions of the Highland Society of Scotland, N. S., vol. ii. p. 127; and various remarks upon the construction of kilns, with explanatory engravings, in Malcolm's Comp. of Mod. Husb., vol. i. pp. 58—73.

† It is said 'that limestone can be burnt to better purpose, and at less expense, with peat, or turf, than with coal. When coal is used, the limestones are apt, from excessive heat, to run into a solid lump, which never happens with peat, as it keeps them in an open state and admits the air freely. The process of burning, also, goes on more slowly with coal. No lime can be drawn for two or three days; whereas, with peat, it may be drawn within twelve hours after the fire is put to the kiln; and in every succeeding day, nearly double the quantity of what could be produced by the use of coal. The expense, too, is comparatively trifling, as a man and a boy will dig as many

an attached lime-house of 40 feet by 20, with walls 14 feet high, and a slated roof, only cost 60 guineas at the time it was erected. It would now probably cost considerably more, but still, when divided amongst a number of even middling farmers, the benefit which they might derive by its use would be considerable; for they appear to pay dearly at present for lime, and the sorry *pot-kilns* by which it is manufactured are so badly managed, that the use of it as a manure, though limestone is plentiful throughout the country, is yet upon a comparatively limited scale. Added to this, it has been broadly asserted, as a complaint that is not uncommon in England, that the professed lime-burners have their bushel measures made of basket, which, as they soon wear away at the rim, annually diminish in size; so that carriages that formerly were known to contain only a certain measure, now carry considerably more *.

Although a kiln, such as that described, is comparatively cheap, yet there are many parts of the kingdom where the consumption of lime is not sufficient to induce the erection of permanent works by dealers, notwithstanding its use might be very advantageous, especially in bringing waste land into a state of cultivation. Even where coal is not found, yet, as such soils generally abound with peat, lime may be economically burnt upon the land wherever there is limestone within a convenient distance; of which an account has been lately published by Mr. Wallace, of Wigton, from which we extract the following particulars.

If peat be used, it should be first pared and dried. The site on which this substitute for a regular kiln is to be formed should be circular—say five or six yards in diameter: the soil should be dug up from off the subsoil; and then the operation of burning is to be performed in the following manner:—In the bottom of the pit lay a large quantity of furze, heath, or ling, upon which place about 2 feet in thickness of the parings, in the centre of which begin to form a funnel, or flue, of furze, encircled by peats, and around this lay about 6 or 8 inches deep of limestone, broken in small pieces. Then carry the flue up a couple of feet higher than the limestone, adding afterwards another layer of furze and parings about one foot deep, and then limestone, layer after layer of each, but still continuing the funnel; observing, however, that the circumference of each layer is to be lessened, until the whole assumes the form of a cone, or sugar-loaf, with the flue for its apex, or point. When this is done, brushwood, furze, heath, or any combustible matter, must be piled around, with peats to keep all together; and if the soil contain clay, clods may be added. Then set fire to the furze at the top or point of the flue, and the whole heap will burn down to the bottom with such effect, that within twenty-four hours the limestone will be completely calcined. If clay be added, it will also become sufficiently hardened to be easily reduced to powder, in which state, as we shall hereafter see, it may be converted to valuable manure; and the ashes may also be used as a dressing †. This method of burning lime has also the further

peats in one day as will burn 180 bushels of lime; and the expense, including drying, is not calculated at one-half that of the coal necessary for burning the same quantity of lime.'—Farm. Mag., vol. iii. p. 483.

* Kent Report, 2nd edit. p. 161. We also learn from Mr. Rawson,—as a hint which may prove useful to extensive farmers who have occasion to prepare large quantities of steamed food for cattle,—that he has, for several years, made use of a small kiln, constructed adjoining to his kitchen. The kiln-fire communicates with flues which heat all the necessary cooking apparatus; and thus dinner has been frequently dressed for fifty persons. A cowl over the chimney carries off the steam and sulphur; and there is a stage over the kiln for drying corn. Were the lime sold, it is calculated that it would more than pay for the whole charge of fuel and attendance.

† Quart. Journ. of Agric., vol. i. p. 187.

advantage, that these pits may be dug on every part of the land where it may be wanted, as they may be filled up with the soil previously taken out of them; or if it be also an object to burn clay, the operation can be performed at the same time, and a great portion of the expense may thus be saved.

The kilns employed for agricultural purposes in this country are generally placed against a high bank for the greater convenience of charging. They are mostly built with brick, but are commonly so ill constructed that they allow a great portion of the heat to be lost, consequently occasioning the loss of a great quantity of fuel,—which usually consists of faggots and furze,—and burning the lime imperfectly. There is, however, an economical mode of burning lime in stone-pits—or *pye-kilns*, as they are in some places called—detailed in the Survey of Derbyshire. It is in use by some farmers solely for their own land, but care is requisite when the process is performed by unpractised persons, as lime—particularly of the hot sorts—if burnt with too violent a fire, is apt to melt and run together, in which state it will not slake, and becomes useless, or what is termed *over-burnt*, and, in some places, *dead-lime* *. The fuel there used is coals; and it is calculated that about 25 tons will make 2400 bushels of good lime.

COMPOST.

Independently of the mixture of lime with the soil in the manner already stated, great advantage may also be gained by making a *compost of lime and earth*, which has been found to possess more fertilizing properties than when it has been laid naked upon the land; and a far less quantity is found to answer the purpose. The great objection raised by most farmers is the heavy expense of labour, and also cartage, which is, in many situations, so great as to prevent the operation. It should, however, be observed that the compost is, in many cases, chiefly composed of the scourings of ditches, and of pond-mud, in which instances the charge of labour must necessarily be incurred, and a great portion of the cost is thus saved. Another mode of reducing the expense is also to plough up the headlands of fields in which the compost is intended to be laid. This is effected by ploughing the land as deeply as it will admit; and if the subsoil be not of such a quality as to occasion sterility, this mixture of fresh earth along with the surface-soil and lime will prove highly advantageous. Virgin earth, indeed, if not in itself a manure, readily unites with lime, and richer composts are thus made than with earth taken from the surface: the expense, too, is less, for a smaller quantity of lime can be made to answer the purpose. The lime should then be laid on in the state of shells, before it is slaked, and ploughed well in, to ensure its complete combination; the loose earth which escapes from the side furrows should then be shovelled up and thrown over the heap, after which a fermentation takes place within a very short time, if the weather be damp and warm, and the compost should be immediately laid upon the land, in quantity according to the quality of the soil to which it is to be applied. From 40 to 50 double cart-loads have been found a full dose to ordinary land, of which only one-seventh part of the compost was quick-lime, which was considered equal in force to one-third of that which had been slaked. Nothing, however, can be more uncertain than the quantity of lime required, for it depends both upon the quality of the lime and of the earth with which it is to

* Derbyshire Report, vol. ii. pp. 415, 440. See also other modes of burning lime with peat, as detailed in the Annals of Agriculture, vols. xxiv. p. 8, and xli. p. 318.

be mixed, as well as the state of the weather; but, from trials which have been frequently made, it would seem that two bushels of lime-shells will be sufficient for a cubic yard of earth of average quality; and 64 cubical yards of the compost—when properly prepared and applied to the soil—may be deemed a moderate dose for an acre of land; indeed, 40 have been considered a good dressing for light land, though more might unquestionably be, in most cases, laid on with better effect*. A dressing of this kind has been frequently found more effectual than one of farm-yard dung, which has been proved by such numberless experiments, that it is only necessary to mention the following:—

1. The headlands of a strong soil, far from being of good quality, and the scourings from the bed of a small stream, having been collected and ploughed up, lime was mixed in a compost to the extent of about 96 bushels per acre, and laid upon a summer-fallow: the remainder of the field was dunged; but the superiority of the compost was evident, especially after the first crop. The effects of the dung also sooner ceased; and the ground where the compost was used was more pliant and easier wrought than where it had been omitted.

2. Some old yards, of a soft and sandy loam, were ploughed up with a deep furrow, and sufficiently harrowed in the beginning of winter. Lime was then added, and turned in by the plough directly, in which state the ground remained till the spring, when it was ploughed and harrowed again, and carted to the field in the month of April, preparatory to barley being sown. A succession of good crops, of the same superiority, was the consequence †.

It would from this appear that, whether the compost consists of lime in a *hot* or *effete* state, it will act effectually, provided the condition of the ground upon which it is to be used be such as to render a calcareous application beneficial; though there can be no doubt that the action of the former would be the most powerful. It must also be observed that, if the compost be composed of alluvial soil from the scourings of ditches, or pond-mud, or from peat,—which substance will be separately treated of,—perhaps three-fourths of the quantity already mentioned may be found sufficient. In contradiction to which, we extract, however, the following account of a trial made by Mr. Bailey:—

3. This compost was of lime and decayed vegetable matter cut out in drawing a bog, the site of an old pond of thirty-two acres: when mixed and mellowed, after frequent turnings for two, three, or five years—for some was not ready till then. It was chiefly applied on the fallows of old worn-out tillage land, of a light nature, in one field of which the ridges were covered with the compost, and ten missed alternately; and about 30 loads were also spread pretty thick on a sandy-soiled grass-field: but all without any apparent effect ‡

Upon which it may, however, be observed, that the lime, if in a large quantity, may have been improperly laid upon 'worn-out tillage,' and that the site of the pond, although described as consisting of decayed vegetable matter,

* Brown, of Markle, vol. i. p. 409. 'If 80 cubic yards are considered to be a good medium dressing for a Scotch, or 64 for an English acre, 160 bushels of lime-shells will be sufficient. Now, the length of a head-ridge opposite to four ridges of 18 feet is 72 feet, and its breadth 18 feet. If this space be ploughed 10 inches deep, it will produce 40 cubic yards of earth at each end of the ridges; while the whole work may be executed by horse-labour.'—Gen. Rep. of Scotland, vol. ii. p. 549.

† Farmer's Magazine, vol. iii. pp. 328, 329.

‡ Survey of Durham, p. 219.

may have also contained noxious substances which did not fall under the notice of the surveyor.

We cannot close this chapter without also adverting to the very just opinion generally entertained, that '*soils ought to be crossed;*' or, in other words, that composts, of which clay is the basis, should be administered to light soils; and the reverse. A petition has, indeed, been lately presented to the House of Commons, stating, 'that there are few districts of the kingdom, however sterile, which may not be brought to a successful imitation of naturally fertile soil by a *well-proportioned mixture of clay, sand, and lime* *;' and there can be no doubt that this amelioration of the soil, by the addition of earth of an opposite quality to that of which it consists, will, where such improvement is requisite, be found of great benefit to the land, for each acts as an alterative, and imparts properties in which the soil was previously deficient. The expense is, however, in most cases, so enormous, in consequence of the vast quantity which must be laid on to produce any sensible effect, as seldom to leave any profitable result. When the earth which is required to be added is to be found in the subsoil, then, indeed, if it be not at too great a depth, it may perhaps be dug, at those seasons in which labour is cheap, at a moderate expense; but those instances are rare, and the charge of cartage from a distance must prevent it from being undertaken by any man, although the owner of the land, who is not possessed of large disposable capital, or by any tenant who cannot secure the return of the outlay within the currency of his lease. Composts, however, may be very advantageously formed in the manner we have stated—by a mixture of lime with the earth on which it is to be laid.

Chapter XIII.

MINERAL MANURES *continued.*—MARL.

MARL

Is a compound calcareous earth found in most parts of the world, and has been extensively used throughout this kingdom, where it is supposed to have been known to husbandmen at a very early period of our history. There are, indeed, leases on record, granted in the reigns of Edward I. and II., which compel the tenants to make use of it†; but, though still employed, it has been in a great degree superseded by the more recent introduction of lime, of the properties of which it in some measure partakes. The

* Petition of Edw. J. Lance, Surveyor, presented on the 29th of February, 1832.

† The Charta Forestæ, passed in 1225, mentions the right of sinking marl-pits; and Daines Barrington gives a quotation from Pliny (lib. xvii. c. vi.), in which he mentions a substance used in Britain and France as manure, called *marga,* which he conceives is a mistake for *marla.* And in the Statutum Wallice, 12 Edw. I., the sheriff and coroner are directed to inquire as to marl-pits adjoining public roads, showing its then common use. The uses of marl and lime are indeed mentioned in a treatise on rural economy written in the Welsh language, and supposed to be from three to four hundred years old; of which a translation has been given by Mr. Davis, in his Survey of South Wales. It contains many curious and valuable remarks, which show that ignorance on the subject of agriculture did not prevail at that time to the extent which is generally imagined.

term denoting it was formerly used in a very vague sense, for it is a substance consisting of various materials, and it has consequently happened, that what has been supposed to apply to one species, did not hold good when affirmed of another. Although principally deemed valuable on account of the calcareous matter which it usually contains, still its composition differs so essentially, that its influence as manure is but imperfectly understood; yet theoretic writings abound in general directions for its use, which are frequently found not to answer in practice, for their rules are drawn either from statements which have been made of the effect of its application on particular soils, or from analyses of its qualities, which, as these vary in innumerable instances, frequently lead farmers astray. Its real value can, therefore, be only ascertained through the practical experience of those who have either actually tried its efficacy, or who have witnessed it in their own neighbourhood.

This ignorance of the distinguishing properties of marl has necessarily led to many mistakes in its application, which have occasioned the variety of opinions that are entertained regarding its use. In most places where it was anciently employed, and where its fertilizing influence was discovered to be eminently great, it was thought by many farmers that it could be made to supersede the use of dung; they, therefore, in many instances, sold their hay and straw, and although, notwithstanding this reduction of the quantity of putrescent manure, they still for a time obtained large crops, yet, eventually, the chemical effects of the marl exhausted the land. No second marling could operate upon it until it had been renovated by repeated applications of dung; and thus has arisen the old saying, cited by Barnaby Googe, who wrote so long ago as the middle of the sixteenth century, that '*lime and marl are good for the father, but bad for the son.*' In this manner, also, some valuable discoveries in agriculture have fallen into disuse through their mistaken application, when governed by local circumstances which were ill understood; but wherever marl of a kind adapted to the soil has been applied, and that a judicious system of culture has been pursued, without either over-cropping, or neglecting the use of putrescent manure, the proverb is so far from being well founded, that the contrary may be safely affirmed.

The common *definition of marl* given us by the best writers on fossils, is,—that it is composed of clay, sand, and lime, very intimately, but unequally mixed, slightly coherent, not ductile, but stiff, or viscid, when moist; most easily diffusible in, and disunited by, water, or even by exposure to the air, and by it reduced to a soft, loose, incohesive mass—for the most part composed of nothing more than calcareous earth—in which its chief value consists—combined with a little mineral oil, clay, and sometimes with ochre, or iron. It is also generally considered as a characteristic of marl, that it effervesces with acids, though to that various exceptions have been discovered; from which it has been supposed that, when deprived of that test, it contains no calcareous matter, yet it is found to produce ameliorating effects upon the soil *. Notwithstanding this summary description, its appearance is, however, as varied as its properties, being of colour nearly pure white, to the darkest shades of brown and red, interveined with blue and yellow. It also exists in different kinds of land, is seldom found as a

* A bluish marl much used in some parts of Ireland, and long celebrated as a manure, makes no ebullition with acids; neither do several of the red marls; yet many of them are known to be productive of great improvement to land.—See Dr. Rutty's Essay on the Natural History of Dublin, appended to the Survey of the County; and also Holland's Survey of Cheshire, note, p. 225.

stratum of much length, but generally in detached masses at various depths, sometimes in wide and dense perpendicular layers, at others in streaks, running in lines parallel with the horizon, or again intersecting each other at right angles, usually resting on sand or gravel, and is classed, according to its qualities, into the following distinct species.

1. *Clayey marl*, which improves sandy land, and seems to act as clay in changing the nature of the soil. In land consisting of a mixture of sand and loam, or of sand and gravel, then, the application of this marl has been found peculiarly advantageous: and on all poor and thin sandy soils there is this further advantage in its use—that, from the large proportion of clay which it usually contains, it adds to their bulk and firmness, and thus has a tendency to bring them to that medium state which is the most favourable to the purposes of vegetation. It is more soft and unctuous than clay; indeed, upon slightly cutting it, it becomes so flexible, that it may be kneaded like dough, or paste, though, when the moisture evaporates, it falls into pieces: it therefore blends easily with the soil, and partaking more largely of calcareous matter, its effects, though slow, are in all the latter cases more fertilizing.

2. *Sandy marl*, which is far more frequent in Ireland than in any part of England, and is commonly found in pits of limestone gravel, whence it is in that country usually called limestone-sand. It is seldom clammy or unctuous, like the clay marl, nor does it adhere to the tongue, but crumbles between the fingers, and feels gritty; when exposed to the air and moisture it slowly chips and moulders; and it partakes of some extraneous mixtures. Its colour is sometimes like that of lead, or brown, approaching to black, and at others blue. As implied by its name, it contains an excess of sand over that of clay; for, upon analyzing it, the proportion of the former has, in most cases, been found to be from 60 to 80 per cent.; and it does not effervesce with acids so quickly as the calcareous marls. It possesses but a small degree of tenacity, and it has proved an excellent manure for clayey soils, mellowing their stiffness, and rendering them easier to work.

3. *Slaty or stony marl*, to which class, also, properly belongs that which is called *rotten limestone*, is chiefly applied to heavy land. Its operation is slow, but very lasting; land, forty years after it has been laid on, having been found to bear a closer and a better crop of grass than that which had been recently applied.

4. *Shelly marl*, which is evidently produced by the remains of testaceous fish, which, dying in their shells, become, in process of time, converted into calcareous earth, and their bodies, when decomposed, furnish a kind of mould composed of animal substance, which is no doubt analogous to the effect of dung. It is, therefore, highly fertilizing when judiciously applied to soils of every kind, which are either in themselves dry, or which have been properly drained.

Such are the most common denominations by which marl is usually distinguished, though it is susceptible of many subdivisions by those who affect to treat the subject scientifically. It is, however, more frequently classed under the sole characters of *siliceous*, *argillaceous*, or *calcareous*, according as sand, clay, or lime predominates in its composition; but, for all practical purposes, it may be sufficient to divide it into *earth-marl* and *shell-marl*.

EARTH-MARL.

The former, though in substance, as we have already seen, sometimes principally formed of sand, is yet, in most cases, chiefly composed of clay

and of the carbonate of lime, intimately combined, but mixed in very different proportions, by which its properties are necessarily varied. It acts as manure physically, or substantially, through the effect of the clay in rendering soils tenacious; and chemically, by the operation of lime in the manner which has been explained in treating of that fossil. These two substances are so completely amalgamated, that it is not possible, either by the eye, or even by a microscope, to distinguish the constituent particles of the one or of the other; the fact can, therefore, be only ascertained by chemical analysis, and the means which nature has employed in their combination is yet unknown; for although it might be supposed that mixtures of clay and lime would produce the same effect as marl, yet they will not fall to powder in the same manner when exposed to air; and it contains some other fertilizing qualities with the powers of which we are unacquainted. Thus, in the improvement of Chat Moss, in Lancashire, if a piece of marl was suffered to lie a few months upon the ground, it was found, on raising it up, that a considerable quantity of the moss adhered to it; and if this intermediate substance was examined, it appeared to be a mixture of marl and peat, formed into a mucilaginous mass of a dark colour, and as soft as soap *.

Although it is very generally thought that extreme accuracy in philosophical experiments is useless in the practice of agriculture, yet it is particularly necessary to ascertain the precise difference between these modes of action; for, of course, either one or the other prevails, according to the greater or the less quantity of clay of which the marl is composed. Thus, to produce the first-named, or physical effect, a much larger amount must be laid upon the land than when the second is the object; for clay can only be advantageously employed in that view upon soils that are too light, and consequently the marl must be laid in proportionate abundance, or it will not improve the condition of the ground; whilst a clayey soil would, on the contrary, lose some of its good qualities by the addition of marl, after the effects of the lime were exhausted. The intimate combination of these two substances in the composition of marl affords it, however, this advantage—that it divides, and falls to powder, with greater ease than can be effected by any artificial mixture, and therefore unites more readily with the soil.

On the other hand, if the calcareous matter in the marl be combined with sand instead of clay, or that there are, as in many instances, veins of calcareous sand intermixed, then it suits a clayey soil. The proportion in which these substances are combined is, however, so different, that they often vary in the same vein, and it is generally found that the bottom part is more calcareous than the top. From 15 to 40 per cent. is not unfrequently the portion of calcareous matter found in clay; that of a sandy nature generally contains a larger proportion†.

The stone marl of hilly countries is frequently still more abundant in

* Communications to the Board of Agriculture, vol. vii., art. xliv. See also Stevenson's edition of Dickson's Survey of Lancashire, chap. xii. sect. 3.

† *Argillaceous marl* usually contains from 68 to 80 per cent. of clay, and from 32 to 20 per cent of calcareous matter: but it has been found composed of 70 per cent. of calcareous, and 8 to 10 of sand, with clear signs of some iron.

Siliceous marl very often contains above 75 per cent. of sand, consequently chalk and sand are the predominant ingredients.—Kirwan on Manures, p. 13.

The analysis made by Von Thaër, of a quantity dug out of pits at Oldenburgh, in Germany, showed it to contain in 100 parts

Of fine sand	36
Clay of a soapy kind	44
Mould	5
Carbonate of lime	14
Gypsum	1

—*Principes Raisonnés d'Agriculture*, 2de ed. tom. xi. p. 423.

calcareous substance; but it also, in many other places, contains such large quantities of extraneous matter, that it may be properly considered as belonging to the earthy species, and has, in some instances, been laid upon the land to the extent of 400 to 600 single horse cart-loads per acre, which heavy labour renders the use of lime more economical, although carried from a greater distance, except in cases where the chief object is to loosen very stiff clays, on which it acts with considerable effect.

The origin of earth-marl is a subject of curious inquiry. It is an object, however, of only secondary importance to farmers; but we refer those who feel interested in it to an ingenious treatise, which may be found in the Appendix to Holland's Survey of Cheshire*. Those kinds of which we are now treating are often found at the base of chalk hills, or in the valleys formed between them, and have probably arisen from the chalk which has been washed down by the rains, together with the vegetable and animal matter of various descriptions which collect and combine together; for, on analysing them, they are found to contain clay, sand, loam, and chalk, and in proportion to the quantity of other substances with which they are combined, they are either saponaceous and clammy, or crumble if largely mixed with calx. Earthy marls are, however, found in beds of such distinct substance, that a body of sandy marl has been known with a regular bed of limestone under it, and a stratum of clay-marl under that; in which case it is evident that the clay at the bottom, if it was not the native soil, must have formerly formed some part of the hill towards its base. The colour of marl is thus occasioned by the nature of the mixtures of which it is composed; for pure calx, or chalk, being white, necessarily imparts a similar hue in proportion to the quantity of calcareous matter which it contains; while the red tinge so perceptible in much of the clay-marl is a strong evidence of the existence of iron. There is also a sort of clay which, from its soapiness, is often mistaken for marl, though differing essentially in its requisite properties. This earth appears to be impregnated with sulphur, and other mineral substances injurious to vegetation, which renders it expedient that farmers who are not already well acquainted with its nature should either use it at first cautiously, or have it carefully analysed by some competent chemist†.

SHELL-MARL.

Shell-marl is usually of a bluish colour, soft to the touch, and somewhat resembling potter's earth; but when exposed to the air it crumbles, and falls into a powder, nearly in the same manner as lime does in slaking.

The nature of this marl is very different from those of earth or stone; for it contains both stimulant and fertilizing properties which do not belong to the former, and from its effects upon the soil it has been classed among animal manures, though it more properly resembles a compost formed of earth and lime, with animal and vegetable substances, for which reason it is justly considered preferable to the others. It exists at the bottom of most lakes, and under bogs and morasses, or other pieces of stagnant water which have been drained, and might, no doubt, be found in every place where water has originally rested; though, as it is usually under other layers of earth or peat, its depth below the surface is often too great to admit of its being searched for with advantage. Every farmer should, therefore, carefully examine the sides and bottoms of his ditches and ponds, for, by doing so, he may often find appearances of marl in places where it was not

* On the Nature and Origin of Marl, by J. J. Stanley, F.R. and A S.

† See Malcolm's Compendium of Husbandry: Anal. of Man., vol. ii. p. 70—85.

suspected, and large beds of the most valuable sort have been in that manner discovered, which might have remained unnoticed for years *.

It is chiefly composed of those myriads of small shell-fish which, with other fry and insects, usually procreate wherever there are pools of water, and the remains of which have, in the course of past ages, been deposited along with sand and decayed vegetables, or other matter swept from eminences, or by the decomposition of aquatic plants. This process of alluvion has, in the lapse of time, produced those masses of shell-marl which display the most striking effects when employed as manure; for the shells, when decomposed, are converted into lime of such purity, that some moss-marl, examined by Dr. Coventry, was found to contain 84 per cent. of pure chalk—which is more than is generally possessed by the purest lime—and the mould formed of the other substances must be very rich †. It may, therefore, be converted into quick-lime, by burning, or it may be used in its natural state, but then it is not so minutely divisible, nor so soluble in water, and is, of course, more tardy in its operation; its effects, however, continue longer, and it is apparent that, as it contains more calcareous matter than the common qualities of lime, it may be used in smaller quantities. When spread upon grass, or clover, it is found to promote the growth of the herbage, for it partakes of the nature of pounded limestone, and possessing none of the caustic properties of quick-lime, it may be used without hazard as a top-dressing. It also occasions heavy tillage crops; and if the land be not over-cropped before it is returned to pasture, the turf is found to be closer, more plentiful, and sweeter than before; but on cold damp soils, which have been heavily worked, the crops of grain have proved later, and the corn lighter than on land which has been limed ‡.

MARL PITS

The common mode of searching for this, and every other kind of marl, is, by the boring-irons used in seeking coal, and other mineral substances. It may, however, be easily effected by any farmer who has reason to suspect its existence on his own land, by using a long pole, furnished with an iron auger fixed at its end; but if this does not reach the marl within about twenty feet below the surface, the sinking of pits, unless the quality be very superior, will seldom be found to answer the purpose. The pit is usually opened by digging a ditch of four to six feet broad, by twelve to twenty long, the surface earth being generally thrown on one side, and that of the sub-soil, or virgin earth, on the other. The marl is then extracted in square pieces with a small cutting spade, either to its full depth, or to that which it can be taken without danger; for care must be observed in preventing it from falling in, by which serious accidents have very frequently happened. The pit is then either so far filled up as it will allow with the clay rubbish, or other earth of the sub-soil, covered by that of the surface; and if it be not of great depth, it may, with a little attention, be easily

* Malcolm's Compendium of Husbandry, vol. ii. p. 85.

† Farmer's Mag., vol. iv. p. 156. By other experiments made by Sir G. Mackenzie (ib. vol. v., p. 271), it appeared that some shell-marl was composed of

Lime	41 25	in 100 parts.
Carbonic acid	32	
Silex	14	
Argil	4	
Oxide of iron	2 5	
Inflammable matter	2	
Loss	4 70	

‡ Reports of Roxburghshire, p. 136. Forfarshire, p. 407.

brought to a level with the rest of the field: if not, it is in other places formed into ponds; but in that case, or if left in open pits, the precaution should be observed, of either fencing them round, or sloping their sides, so as to guard against accidents.

In those places where marling is regularly carried on throughout the year, it is generally managed by persons who make it their sole business; but when a farmer's teams must be employed, it can be only done from the latter part of autumn until the commencement of the spring sowing, or during the intervals of other work, though it may be carted upon the land at all times which may be found convenient. The expense depends upon a great variety of circumstances, but chiefly upon the depth from which the marl is dug, and the distance to which it is to be carried. The nature of the surface-soil, and the charge of removing it—the tenacity of the marl, and the quantity of water with which it may be covered—all vary according to locality: then the carriage, particularly of clay-marl, is so heavy, that unless it can be found nearly adjoining the farm, it will rarely pay the cost of removal; for the work is so severe that, even in the slack time of winter, the cattle will require better food than is usual at that season, and the wear and tear is also considerable. All weighty considerations, which, when compared with the tenure of the land, deserve mature consideration before the improvement be attempted *.

Tenants should, therefore, be cautious how they undertake it, unless backed either by the security of a long lease, or by entire confidence in the estimation of their landlord; for a very considerable period may elapse before it incorporates with the soil, and, consequently, before any benefit can be received from it. Of which, that able farmer Mr. Macro, of Suffolk, gives an instance, in 120 square yards having been laid upon some very poor soil at an expense that would have purchased the fee simple of the land; yet no visible improvement was effected in comparison with other ground which had not been marled, until very long afterwards, but then it evidently obtained an advantage, which it maintained after a lapse of twenty years †.

APPLICATION OF MARL

Many farmers either lay marl upon land sown with tares, thus making a bastard fallow; or they apply it to grass land, or to a clover ley, to be broken up in the following year. The latter is certainly the preferable, as well as the most general practice, for it not alone produces an abundance of good pasture, but it affords time for the season to operate in bringing the marl into a fit state for future tillage crops, which cannot be done in the common course of cropping, because it becomes buried by the plough

* The price of good marl, when raised by contractors, is charged at such various prices in different places, that we should probably mislead some of our readers if we were to state them. It is computed at separate sums for groundage, digging, and spreading upon the land; but independent of the cost of carriage, which is to be added. We may, however, observe that, when taken from the wastes or commons, it is the practice of some landlords to charge 5*s*. an acre for the land marled; others 2*d*. per farm-horse load; and in some parts of the North the expense has been thus calculated:—paring the marl, say of 3 feet of superficial soil, 12*s*. per cubic rood of 64 yards; getting and filling the marl, 12*s*.; loading it, supposing the pit to be at the distance of 100 or 150 yards, 21*s*.; and spreading, 4*s*. per rood.—Cheshire Report, p. 223; Stevenson's Lancashire, p. 496. In Hampshire, the total charge of marling, when done by the farmer's men and teams, at an average distance of 80 rods from the pit, is stated at 3*l*. 10*s*. per acre, presuming the quantity laid on to be 30 cart-loads of 1¼ ton each; that is, taking common labourers at 2*s*., and horses, including wear and tear, at 4*s*. per day.—Vancouver's Hants, p. 337.

† Annals of Agriculture, vol. i. p. 286.

before it is properly mixed with the soil, especially if turned in deep the first earth. It should, therefore, be allowed sufficient time to sink and eat itself into the surface before it is ploughed up. This, however, is by some persons carried to an absurd length, as they occasionally spread a coat of marl upon the green sward, and leave it there unploughed for many years, in which case the grass receives considerable detriment, for the marl then sinks downwards in a body, without incorporating with the soil; though, when it has lain a long time in this state, the subsequent crops of corn have been found to be enormous *. If laid upon grass, it may be carried out during all periods of the year in which the crop is not in a forward state of growth; but if applied to arable land intended for immediate cultivation, the months of June and July, or soon after the autumn seed-time, are considered the best for its application. If laid on a short time previous to winter, its effect is also generally prompt, because, except it be of a very tenacious kind, the action of the cold and rain commonly divide it in time, to be thoroughly amalgamated with the soil by the tillage of a summer fallow. If, however, it be only applied during the spring months, this cannot be so properly carried into execution, for it requires the winter's rain and frost to crumble it, and it consequently has but little power upon the year's crop. A complete summer fallow is, undoubtedly, the best mode of bringing it into perfect operation: but not only is the expense often objected to, but there is also a strong prejudice entertained by many persons against fallowing—into which it is not our present object to inquire, although we necessarily shall have occasion to notice it hereafter.

It is almost superfluous to add, that, in whatever manner it be applied, it must be equally spread over the land; and if there should be any large lumps remaining, these should be broken with mallets, or clotting-beetles, in the same manner as chalk, before it is ploughed in. This, however, is not usually done until the marl has partaken of both one summer's sun and one winter's frost; and should the previous season have proved unfavourable to the reduction of the marl to small particles, the process, in some cases, costs so much, that, when laid upon grass or clover, it is often found more advisable to leave the ground unbroken during another year. Then, when well crumbled, dry weather should be chosen for rolling and harrowing it—a first time with heavy rollers and drags, and a second, after it has been exposed to rain, and has been again dried: in short, until it has been rendered as small as possible; after which it should be lightly ploughed in, again harrowed, and receive from two to four ploughings, according to the condition of the soil. The intermixture of the marl with the earth cannot, in fact, be too complete; for whatever proportion remains uncombined with the soil, will not alone fail of producing the intended effect, but will have one of an opposite and prejudicial tendency.

The *quantity of marl* which it may be prudent to apply to the land depends entirely on the nature of the soil, and the properties of the marl: the more calcareous is the latter, the greater is the effect which it will produce, as a stimulant; and shell-marl possesses, besides, the additional power of nourishing the soil by the vegetable and animal mould with which it is combined. This species was formerly profusely used on every sort of ground, but at present the average amount applied to land of the medium kind is from 30 to 40, or, if it be very light, only 25 cartloads, of 16 cubic feet per acre Land of the latter quality may, indeed, be readily over-marled; as by repeated marling, in large quantities, the surface of poor ground may

* Dickson's Original Report of Lancashire, Stevenson's edit., p. 490.

be rendered so loose that, in some cases, it has not afforded a sufficient hold to the roots of corn and grass*. Double the quantity may, however, be laid upon strong cohesive soils, for it is not so easy to give them too large a dose; but if cold, wet, or moorish, great circumspection is requisite in the application of this marl, for if the land be not previously well drained, it will only increase its tenacity.

The earthy marls, if much mixed with clay, are only fit for light soils; and, if applied to them, the quantity must be increased in proportion to the deficiency of calcareous matter. When of good quality, containing about 20 to 25 per cent. of calcareous or chalky substance, they are commonly laid upon such land to the thickness of an inch; which will require 135 cubic yards, or about 200 single-horse cart-loads per acre †. Sandy marl, though generally more calcareous, yet being dug up with less labour, is often used upon clays with greater freedom; and we have already seen the great extent to which stony marl is sometimes applied ‡. In many parts, however, where the effects of marl have been extensively experienced, these quantities have been diminished one-half, with nearly, if not entirely, the same immediate effect upon the crops, though its power has been less durable, and has in most cases altogether ceased at the end of at most a dozen years; but, then, it admits of the following advantages—a farmer may be able to afford half the expense, when the whole amount may be beyond his means; or, at the same time, he can marl double the extent of land, and he can reap all the probable benefit within the term of a moderate lease. Nor is this all; for, supposing him to have the freehold—it has been found, that when large quantities of marl have been laid upon the land, though its effects last longer, yet, unless cultivation be carried on with great intelligence and care, these are at length worn out, and by severe cropping to repay the expense, large tracts of marled land have been much exhausted. In such cases, too, a second application has been attended with very little benefit; whereas, when it has been laid on in moderate quantities, a second and further applications have been successful; the reason of which evidently is, that, in the first instance, the fertility of the mould was either exhausted by the chemical effect of the marl, or that, the soil being of a heavy kind, and the marl containing too great a proportion of clay, this addition became injurious; while, in the second, dung had been applied in aid of the marl, or, its earthy properties being of a nature opposed to those of the soil, assisted in its amelioration. The latter of which suppositions is, indeed, supported by the fact, that when a second application of clay-marl has failed, lime has been laid upon the same land with sensibly good effects §.

It has also been observed, in those places where marl is applied to the land in small quantities at stated distances of time, and where a sufficiency of dung is likewise used, that when weeds of any peculiar species push forward with extraordinary vigour, marl, if accompanied by a clean fallow,

* Perth Report; and Appendix to that of Cheshire, No. 3.

† Clay-marl is not uncommonly laid upon light soils to the extent of two roods, each containing 64 cubic yards; but on heavy land, half that quantity per acre is considered a good covering.—Cheshire Report, p. 222.

‡ See p. 308. Throughout many parts of Scotland it is applied at the rate of 200 to 300 small cart-loads per Scotch acre,—equal to 160 to 240 per imperial acre. It is there commonly applied to grass land, and allowed to remain one or more winters on the surface, until completely reduced by the frost.—Survey of Morayshire, pp. 21-320; Forfarshire, p. 407.

§ Berwickshire Report. Naismith, on Manures. Gen. Report of Scotland; App. vol. ii. p. 75.

not only destroys them, but produces better corn than when dung has been laid on alone, though also upon a fallow, and instead of marl; which has been thought to be accounted for by the exuberance of the weeds proving that the soil is already abundantly furnished with nutritive matter for the promotion of vegetation, but that it is more appropriate to the production of the weed with which the ground is covered, than to cereal crops: whence it has been inferred, that the chemical action of the marl probably changes the nature of the mould *.

The *durability of the effects of marl* necessarily depends upon its power over the soil. A very large dose of argillaceous, or clayey, marl ameliorates sandy soils to such a sensible degree by the consistence which it affords to the land, that, if proper attention be paid to its complete combination with the surface, and to the prevention by careful culture of its sinking to the subsoil, as well as to the employment of putrescent manure, the improvement thus effected will be found permanent. When laid on in smaller quantities, its effect and duration will, on those light soils, of course, be proportionate; but on clays, as its chief power consists in the calcareous matter which it contains, its greatest effect is apparent when the land is brought into the second course of tillage, after which it gradually begins to decline, and after six or eight crops have been grown, it usually ceases to operate. No rule can therefore be laid down for its value among tenants upon a change in the occupation of the land, and it can only be estimated by the opinion generally prevalent throughout those parts of the country where it is used.

It is extensively employed throughout Cheshire, Lancashire, Shropshire, Staffordshire, and most of the midland counties, in almost every part of which it is found, but in the greatest abundance where the prevailing soil is a clay, or a clayey loam. It is there generally red, dark brown, or bluish-grey, intersected with veins of light yellow, of a greasy touch when moist, and friable when dry: the land where this species of marl forms the subsoil is likewise very commonly found to be of first-rate quality. There is also an excellent kind of marl sometimes met with, which is vulgarly called *dove-dung*, from resembling that of pigeons. Under sandy or mixed soils it is also very frequently met with, but usually at a more considerable depth. It is sometimes laid on the green sward in winter; and after being acted upon by the frost, is ploughed in the following spring, usually for oats. If, however, allowed to lie for twelve or eighteen months, it will have a still better effect; for the successive changes of the atmosphere moulder it down, and the roots of the grass combine it with the surface of the ground, by which means it becomes more beneficial to the following crop than if stirred immediately by the tillage of a fallow†. Marling on fallows is, however, practised to a very considerable extent, and is there found generally productive of great benefit to the soil. It is spread, immediately after being carted, upon the land, but its pulverization is left almost entirely to the atmosphere. Some kinds are much more easily reducible to a powdery state than others, and the difference determines, in many instances, the propriety of their respective application. On the stiff clay lands, or where immediate crops are the direct object of marling, those marls which pulverize with the greatest rapidity on exposure to the weather contain the largest portion of calcareous matter, and are, therefore, found the most beneficial. On light sandy soils, or where marl is employed with

* Thaër, Principes Raisonnés d'Agriculture, 2de ed. tom xi. p. 415.

† Arthur Young's Essay on Manures, in the Papers of the Bath and West of England Society, vol. x., p. 106.

a view of producing durable effects, the more tenacious kinds may also be used with even greater advantage. Under the latter mode of application, the effects produced on the soil are not, indeed, evident until after repeated ploughings, and they frequently continue to manifest themselves during a long period *.

There is, however, a bad sort of red clay-marl, as well as a kind of brown shining clay, sometimes mistaken by farmers for marl, which, having been dug out of almost every field, and laid during many ages on some heavy soils, has increased their tenacity, and rendered them less fit for the purposes of agriculture. Its effects are, indeed, so apparently unfavourable, that its further use has been prohibited to the tenantry on the estates of the Duke of Sutherland, in Staffordshire and Salop, and a distinct line in the appearance of the crops now points out with precision the land which was formerly so treated. Of this fact all the intelligent part of the tenantry are themselves convinced, though some are still so wedded to their old customs, that they lament the regulation which excludes its use †.

Marl is, also, generally used in Norfolk, in which county it is found of better quality, and of easier access, than in most other parts of the kingdom. By Mr. Blaikie, it is described as having a hard, dry, and slaty appearance, when first dug from the pit, and possessing about the same proportion of lime as the Norfolk clay, which contains a large proportion of calcareous earth; the only difference between them seeming to consist in the one being a little more friable than the other; so that they are very commonly confounded,—'one practical man calling that substance clay, which another, equally conversant in such matters, terms marl ‡.' By other persons, another species is mentioned as a white, pure, calcareous substance, like chalk, though sometimes streaked with yellow, but fat and unctuous. When found of any other colour, it is, indeed, said that farmers can scarcely be persuaded that it is marl; but although this kind possesses greater purity than the former, yet there are many other sorts of very strong quality. On its first discovery it was seldom laid upon the land at a less rate than from 80 to 100 loads, each containing as much as a waggon with three horses could draw, and its effects were found to last, on some soils, full twenty years. This system has, however, been latterly corrected, and the quantity now laid upon the land does not usually exceed 40 to 50 tons per acre. It imparts tenacity to the soil, and where that is composed of a mixture of sand and loam, or of sand and gravel, it causes great improvement; but on land of so loose a texture as to consist almost wholly of sand, it has been found, in the course of years, to form a retentive subsoil, which has proved injurious. It has, indeed, been shown, in some instances, that on land of the latter description clay has had a better effect.

In the earliest stages of improvement in the Norfolk husbandry, some farmers, from experiencing the evils of a want of firmness in their poor sands, marled at the rate of 120 to 150 cubical yards per acre; the consequence of which was what they call *setting*: the firmness was produced, but at the expense of the friability of the soil, which was thus rendered too tenacious, so that it is at present found preferable to give a moderate dose at first, and to repeat it at a future period. This prejudicial effect, arising

* Holland's Survey of Cheshire, p. 233.

† Loch's Account of the Improvements on the Estates of the Marquis of Stafford (now Duke of Sutherland), p. 190.

‡ Treatise on Mildew, 2d edit. p. 26. 'The substance called clay, in many other districts, contains a larger proportion of alumen, or clay proper, with a very limited quantity of lime, and is, consequently, not adapted for husbandry purposes; at least, not upon tenacious soils.'

from marl, is very remarkable; for the clay, sand, and lime of which it is composed would not, if thrown promiscuously over a field, produce the same effects; and when laid upon the land, they indicate no improper proportions, nor any which are not found in very rich soils. It may, therefore, contain other ingredients which have not yet been detected by chemists; and, as has been imagined—perhaps not unjustly—by Arthur Young, 'it arises from the addition not being so well assimilated with the sand, as in soils of a natural texture it is rather a mixture than an incorporation*.' There is, indeed, reason to suppose that marl derives much of its beneficial qualities, as a manure, rather from the complete amalgamation of the various substances of which it is composed, than from any other cause.

Mr. Marshall, in his Rural Economy of Norfolk, enters into a chemical investigation of the nature of the marls, which, though too long for insertion here, is well worthy of attention; in which he describes that of the white, or rather yellow, kind, as one of the best and most lasting species of fossil manures. Twelve cart-loads—according to his account—change the nature of the land in the second year after it is laid on; and most of the exhausting weeds which impoverish the soil, and choke the corn in its infancy, being effectually destroyed, it consequently has a great tendency to keep the land clean; also bracing the pores of the earth, and increasing its fertility to a surprising degree. Its benefits, he says, are felt throughout full thirty years; when a second marling of about half the original quantity may with propriety be used; but it has been found, by experience, that it does better the second time, if applied as a compost with earth of a sort different from that of the soil on which it is laid; or with mud, and more especially with dung. To this it may also be observed, that lime is not unfrequently added; though, as lime and marl both partake of the same properties, the mixture of the former only has the effect of strengthening the compound.

It thus appears that not only do the species of marl vary in several parts of the kingdom, but in some parts there are kinds which, though seemingly quite distinct from each other, have yet been found, on trial, to possess precisely similar qualities; for we learn that experiments on a considerable scale have been tried in the New Forest, in Hampshire, on three different sorts, dug out of the same pit, namely,—yellow, at about four feet below the surface, blue in the middle, and shelly-marl underneath; and yet, although from all the accounts which have been received of the latter, its properties are superior to those of the two former, still, in these instances, no other difference was observable in the crops during many years, except that the shell-marl rendered the land rather the most friable †.

That marl materially benefits land on which it is judiciously used, admits of no kind of doubt. Much difference of opinion is, however, entertained respecting the manner in which it operates,—most farmers conceiving that its only value consists in the calcareous matter with which it is combined; others, that its principal advantage arises from the bulk and consistency which it imparts to the ground; and some, that the improvement which it occasions is chiefly owing to its mechanical action on the texture of the soil. Upon an attentive consideration of the subject, it will, however, appear, that a certain portion of its utility as a manure is derived from each of the three sources which have been assigned. With regard to the calcareous earth of which it is partly composed, it clearly possesses, in extent equal to the proportion which it contains of that substance, the same power

* Papers of the Bath Agricultural Society, vol. x. p. 108.

† Communications to the Board of Agriculture, vol. vi., art. 3.

that would be produced by the direct application of a similar quantity of lime. It is, however, apparent that some descriptions of marl, though advantageously employed on most soils, do not contain any, or only a very small portion of the carbonate of lime; its efficacy therefore cannot be solely attributable to that cause *, and it must possess some other property from which its influence upon the land is partly derived. This may consist either in the change which its application produces in the texture of the ground through the mere increase of its bulk, which, by its dense and unctuous quality, also adds to the consistence and value of all light soils; or, by the more perfect combination of the particles of which it is formed, by which its powers are brought into full action, and lime, sand, and clay are each made to bear against each other, and thus aid its mechanical operation on the land. All marl, except those species which are combined with large portions of iron, sulphur, or deleterious mineral substances, also of itself affords nourishment to corn and vegetables; it must, therefore, be considered as a soil, and when laid upon the land, this addition must necessarily yield a more abundant support to succeeding crops.

If this view of the subject be correct, it may be assumed, that all kinds of marl which abound in calcareous matter may be considered applicable to every soil to which lime is beneficial; subject, however, to the effect which may be also produced by the other portions of their substance when applied to land of a peculiar nature. Thus—as we have already more fully stated in the preceding part of our observations—on light, sandy, and gravelly soils, an advantage is gained by the large quantity of clay which the marl appropriate to such land usually contains, by rendering them more stiff and impervious to the rain, and therefore stronger: on wet and heavy lands, on the contrary, as it renders the soil more retentive, unless very great care be bestowed on their drainage, it may occasion permanent injury; but shell and stone-marl occasions it to become loose and friable. Attention should therefore be paid, not only to the nature of the marl, but to that also of the soil to which it is to be applied; and when a choice of marl can be procured, its earthy portion should differ as widely as possible from that of the ground upon which it is intended to be laid.

In fine, marl may be considered as an improver of the soil under so many different circumstances, that it can hardly be recommended in too strong terms; for if it be used with judgment, it adds staple to the soil, improves its quality, and renders the application of putrescent manure more effectual. The use which some farmers make of it, however, deserves the highest censure,—'many of them taking repeated crops of oats in the interval of one summer-fallow for wheat, by way of cleansing the land: after which, barley and oats again, as long as the land will produce any thing, until it is at last laid down with weeds and couch-grass.' Such is the view taken of their conduct by the surveyor of Lancashire, where it is very extensively employed, and in which opinion he is by no means singular. The rotation which he recommends—with reference, of course, to land that is not too strong—is, to take one crop of oats the spring subsequent to marling; plough the stubble immediately, in order to expose the marl again to the influence of the frost: fallow, with manure, for turnips—a crop which, under this management, is never known to fail; then barley, clover,

* Out of twelve specimens of marl submitted to the inspection of Sir Humphry Davy, eleven were found to contain calcareous earth in various proportions; but the result of many other trials of marls, procured from different parts of the country, and found by farmers to produce an ameliorating effect upon the land, yet proves them to be, in many instances, wholly deficient in that substance. See the section on 'Marl, in Holland's Survey of Cheshire.

wheat, turnips fed off with sheep, and barley again, with well-dressed hay-seeds, and white clover and trefoil for a perennial ley, or at least for some years *. Under which management, poor land may, when properly tilled and duly supplied with putrescent manure, be rendered highly exuberant without being in the least degree harassed.

ANALYSIS OF MARL.

The value of marl, as a manure, must of course be referable to the nature of the different kinds employed. It is, indeed, evident that, being intended to correct or improve the soil, its constituent parts should be known, and their qualities explained, before any use can be rationally made of it; and, therefore, the more accurately its properties are ascertained, the more confidently may the propriety of its application be determined. Farmers, indeed, cannot be expected to be sufficiently acquainted with chemistry to be able to analyze it, though the most calcareous sorts may be known by means of acids, as applied to lime; or, the common earthy kind, when put into water, will fall to pieces, allowing a considerable portion of sand to fall to the bottom of the vessel: by which simple tests, they might often derive considerable advantage. Its qualities are, however, more generally taken, by mere practical men, more upon trust derived from the experience of their neighbours than from any actual knowledge of its properties; but although, when thus guided, they cannot go far wrong, yet they may be misled by circumstances of slight apparent difference, and, in cases of new pits being opened, no certain estimate of its effect can be formed until a complete analysis has been made. This should, indeed, be done in all such instances; for it costs but a trifle, is easily performed, and without having recourse for the purpose to a regular scientific chemist, the object may be attained by application to any intelligent apothecary, by furnishing him with the following account of the modes of procedure:—

The ingredient of marls, on which their fitness for agricultural purposes depends, is the carbonate of lime. It is owing to the presence of this earth that marls effervesce on the addition of acids, which is one of their distinguishing characters: to ascertain which—

'Let the marl be put into a glass, partly filled with water, which will expel a portion of acid contained mechanically in the marl, and thus obviate one source of fallacy. When the marl is thoroughly penetrated by the water, add a little muriatic acid, or spirit of salt. If a discharge of air should ensue, the marly nature of the earth will be sufficiently established.'

Then, to find their composition—

'Pour a few ounces of diluted muriatic acid into a Florence flask, place them in a scale, and let them be balanced. Then reduce a few ounces of dried marl into powder, and let this powder be carefully and gradually thrown into the flask, until, after repeated additions, no further effervescence is perceived. Let the remainder of the powdered marl be weighed, by which the quantity projected will be known. Let the balance be then restored. The difference of weight between the quantity projected, and that requisite to restore the balance, will show the weight of the air lost during the effervescence, and will stand thus,—

'If the loss amount to 13 *per cent.* of the quantity of marl projected, or from 13 to 32 *per cent.*, the marl assayed is calcareous marl, or rich calcareous earth.

'Clayey marls, or those in which the argillaceous ingredient prevails, lose only 8 or 10 *per cent.* of their weight by this treatment; and sandy marls about the same proportion. The presence of much argillaceous earth may be judged by digging the marl, after being washed with spirit of salt, when it will harden, and form a brick†.

* Dickson's Lancashire, Stevenson's edit., p. 491.

† Henry's Elem. of Exper. Chem., vol. ii. chap. xv. sect. iii. See also Kirwan on Manures, p. 12.

Chapter XIV.

MINERAL MANURES, *continued.*—GYPSUM.

GYPSUM,

Otherwise *sulphate of lime*, or *plaster of Paris*, as it is sometimes termed, from having been dug in great quantities from the quarries at Mont Martre, is a fossil, of which 100 parts of that kind chiefly used as manure have been described by Chaptal and Buchholtz—both eminent writers on chemistry—as consisting of

Pure calcareous earth, or lime	30 parts	or 33
Sulphuric acid	32 ,,	43
Crystallized water	38 ,,	24

It requires from 450 to 500 times its own weight of water to dissolve it; though reducible to powder in the fire, it is almost as difficult of fusion as limestone, and it loses about 20 per cent. by calcination. When pure, it does not effervesce with acids; it is insipid in taste, and free from smell; but there are other sorts which vary in purity, and hence the analyses of many chemists differ in their accounts of its properties. There is, however, a simple mode of trying its quality, which is common in America, and consists in putting a quantity of it pulverized into a dry pot over the fire; and when heated, it gives out a sulphurous smell. If the ebullition, or bubbling, which then takes place, is considerable, the plaster is good; but if not, it is considered indifferent; and if it remains motionless, like sand, it is thought to be hardly worth anything *. Another test of its goodness is obtained by putting the powder alone into an iron pot over the fire, and when it bubbles, like boiling water, it will admit of a straw being thrust to the bottom without resistance. It is found in this and other countries, in many mountains of secondary height; sometimes in huge semi-transparent masses of great hardness, and also in a state of powder †. In England the chief mines of the stony kind at present worked are in Derbyshire, and that which is in a loose state is principally dug in Nottinghamshire; but it is also known on the coasts of Hants and Dorset, and there is a large vein of it at Ballintrae, in Ayrshire, from whence it may be carried coastwise at a moderate expense. In colour it is generally white or grey, but tinged with darker shades as it partakes of other matter; and when found in a solid form, it is composed of fibres which are sometimes thick, at others fine and subtile, adhering to each other, and very brittle.

The use of gypsum, as a manure, though only of late years brought into general notice, is not a modern discovery, for traces of it are to be found in the writings of the ancients. It was not, however, until towards the middle of the last century that the public attention was attracted to it by

* Parkinson's Practical Observations on Gypsum, p. 36.

† When found in this state, it has, in some parts of the continent, and in times of famine, been regarded as a species of flour sent by heaven for the support of man; whence it has obtained the name of *celestial flour*, and has been made into bread when mixed with that of grain. It cannot, however, be supposed that it really contains any power of affording nourishment; but it does not possess those deleterious qualities which many people attribute to it; and it is said to be used by some bakers to add weight to their loaves.

When made up into a paste, it is also used by printers for retaining an impression of their types, by which simple process the copies of literary works are stereotyped.

so striking at the time of harvest, that, when separately reaped, threshed, cleaned, and measured, under careful inspection, the following was the clear result:—

Gypsum produced, per acre,	4 qrs. 6 bush., at 72s.	£17	2s.
No manure . . .	2 „ 4 „ . .	9	0

Three quarters per acre having been the largest crop ever before grown upon that field during twenty-eight years that it had been occupied by one person, when wheat had followed beans, peas, and trefoil, in the common course of husbandry. When thin upon the ground, clover, if top-dressed with uncalcined gypsum, at the rate of five or six bushels per acre, according as the plants may be more or less thin, has been found to stock out with such luxuriance that a difference of a load an acre in its favour has been observed between that and the same crop, on land of the same quality which had been left without manure. We learn also from Russell, that it has been laid on a neighbour's farm, in Warwickshire, in the latter end of April, 1830, at the rate of about three bushels the acre, and that when mown on the 21st of June following, there was an astonishing improvement in the crop on that part of the field which had been so dressed. Its application to lucerne has also shown it to be productive of equal effect*.

Extraordinary as this may appear to those who have experienced contrary effects from its use, yet these well-authenticated accounts of its efficacy, added to the concurrent testimony of many other eminent farmers, should induce further trials; for conclusions should not be hastily drawn from partial experiments, which are, in many cases, made without due knowledge or consideration of the grounds upon which they should be founded. It is indeed quite incontestable that many of the objections which have been made to its use are more apparent than real; for even the failures in those trials which have been stated almost uniformly consist, not in any pernicious effect, but in the want of any superior returns when compared with unmanured lands of the same quality †. We shall, therefore, endeavour to state, as succinctly as possible, what appears to us to be the real properties of the manure, and the most judicious mode of its application to various soils and crops.

APPLICATION.

When applied *in its raw state*, gypsum is prepared for use by first pounding it with sledge-hammers into very small pieces, and then either grinding it in a mill, or passing it under the crushers of oil-cake, by which about 20 to 25 bushels per ton are produced, according to its state of purity. By the latter process, however, it is not sufficiently pulverized, which is essential to its utility; for if this be not completely effected, not only will a larger quantity be required, but even that will not, in some cases, be found so effectual as the powder. When employed as manure, it is seldom burned, and if used either in its natural state, or *in proportionate quantity if calcined*, no perceptible difference can be discovered, unless heavy rain should fall soon after it has been spread, which gathers it into lumps, like paste, and hardens it; but, if this be guarded against, the only sensible

* Communications to the Board of Agriculture, vol. vi. pp. 233—264. Malcolm's Survey of Surrey, Kent, Sussex, &c., vol. ii. p. 67. Russell's Treatise on Practical Agriculture, p. 110.

† Essay on Soils and Manures, Anon. p. 94.

effect of calcination is to deprive it of its aqueous particles, and thus to reduce its weight; for the sulphuric acid which it contains cannot be expelled by the most violent heat of the furnace *. The only object to be gained by burning it is, therefore, to bring it into as fine a powder as possible, which, when it has been submitted to the fire, is comparatively easy: lying also in a less compass, the carriage is besides cheaper. When sold in that state by the London dealers, it however costs about 4*s*. 6*d*. per bushel; though, when merely ground, without having been burned, but brought to the condition of coarse meal, which answers all its purpose as manure, it may be procured at 2*s*.: we shall therefore confine our observations to its application when raw.

The *soils to which it is the most congenial* are the light, dry, sandy, gravelly, and chalky: to heavy loams, strong clays, and to wet land, it seems to yield no benefit, unless the former happens to have been well limed. It was long thought that gypsum, being itself calcareous, could not be applied with any advantage to soils which were impregnated with similar matter; and as the analysis of its properties shows that it contains both alkali and sulphuric acid, which are known to become neutralized when combined in just proportions, it was also, therefore, generally imagined that its effects upon vegetation would, in certain cases, be scarcely perceptible. These conclusions have, however, led to much misapprehension in its use as a manure; for, in the first case, experience has proved it to be beneficial when laid upon limestone soils, or upon land which has been saturated with chalk or lime †; and, in the second, although alkalis and acids, when acting solely upon each other, are rendered neutral, yet, when the resulting compound is applied as a dressing to land, its effect has in many instances been found eminently useful. The causes which have produced these effects are, however, far too obscure, in the present state of chemical knowledge as applied to the nature of soils, to allow of more than mere conjecture; and would lead to a discussion which could prove interesting to only a very limited number of our readers.

Upon exhausted land, or upon soils containing little vegetative mould, or deprived of putrescent manure, it will prove powerless; but it succeeds well after an application of dung, or of green crops ploughed down. It produces, also, *more effect in dry, than when laid on in wet weather*. A watery temperature, at least, arrests its effects, and seems even to suppress them altogether if the gypsum has been calcined. but it should be observed,

* An experiment made by Arthur Young shows that on two perches of clover, one spread with burnt, and the other with rough gypsum, the difference in the crop, when weighed green, was only 2lbs.—Ann. of Agric., vol. xiv. p. 319. See also the Review of a Treatise on Artificial Grasses, by Mr. Gilbert. published in France, in the same work, vol. xv. p. 444.

On referring to Bishop Watson's Chemical Essays, it is, however, found, that the acid is obtained by being boiled with pot-ashes, in which state it is sold by some dealers; but when thus reduced, and sown in equal portions with the pure sort, upon alternate slips of lucerne and sainfoin, no difference was observable during the first and second years; but, afterwards, the crops spread with that from which the acid had been extracted began to decline. Vol. ii., p. 110.

† See Malcolm's Compendium of Modern Husbandry. vol. ii., p. 60. In proof of this, 'a very poor field of stiff flinty loam having been chalked in one part with sixty, and in another with a hundred, cart-loads of chalk, which were worked into the soil by repeated tillage, was afterwards laid down with sainfoin, sown along with oats, after a fallow, and having been dressed with three bushels per acre of gypsum, has since regularly produced never less than two loads an acre upon that part on which the sixty loads of chalk were laid, and much finer crops on that which had one hundred.'—Comm. to the Board of Agric. vol. vi., art. xxxii.

that this only occurs if rain falls soon after its application; for if it happens previously, its moisture upon the plants will be found useful. This employment of the gypsum, either during the prevalence of rain, or immediately before it has fallen, has given rise to many mistakes, which have occasioned much of the prejudice which is entertained against its use. Thus, in the Sussex Report it has been stated that equal quantities of French and English gypsum were laid, on the 14th of June, on six different fields of a sandy loam, sown with beans, peas, potatoes, and barley, besides natural grass, at the rate of 8 bushels to the acre. On the day it was strewed it was showery, and on the 15th it rained from 10 in the morning till the evening; yet neither in that, nor in the following year, could any greater appearance of luxuriance be perceived than on the surrounding ground. The experiment was also repeated in March and the middle of April upon some patches of red clover, wheat, and spring tares, with similar effect: on both occasions it rained heavily. Thus, not only, as we shall perceive, has it been applied to some crops to which it is useless, but in seasons which were inappropriate, and it has been washed off those plants on the stems of which had it been allowed to remain, it, no doubt, would have been attended with good effect.

The *crops to which it is the most appropriate* are the artificial grasses and leguminous plants, though it has been also known to materially improve the sward of moss-bound pasture. It never appears to produce better effects than when it has been laid on red clover, already so far grown as that the leaves nearly cover the soil; for there seems no doubt that it acts with the greatest force when it adheres to them, and that the longer it remains upon them the better. It should, therefore, be used as a top-dressing, and applied in the latter end of April, or the beginning of May. Besides the effect attributed to its application to the leaves, it has not been found so advantageous when laid on during the cold months of winter, while plants are in a torpid state; though many people spread it in autumn upon the young clover of the first year, and others, after the first cut, which has thus been often known to produce a larger crop than the former. Perhaps, however, these plans might be beneficially combined were the quantity of gypsum divided; one portion to be used as an early sprinkling when the first crop begins to appear, and the second as soon after it has been mown as the new leaves spring up. If, however, the plants of either clover, sainfoin, or lucerne, should stand very thick upon the land, and if the soil be sufficiently fertile to push those first crops vigorously forward, in that case the gypsum would probably be productive of such an excess of vegetation, as might occasion them to become so rank as to rot upon the lower parts of the stem, and its application should be deferred until after the second cutting.

In order to spread it, with the intention of covering the leaves, a calm day should be chosen; and it should be spread by hand, or rather through a sieve, either early in a morning in which the dew has fallen heavily, or late at night, or after a gentle shower, that thus the moisture may occasion it to stick to them. It should be avoided either on a windy day, or when the weather threatens rain; and the powder should be ground fine. The usual quantity varies from four to six bushels; if completely reduced, and of strong quality, perhaps the former will, on good soils, be found sufficient if laid on at once; or, if at two periods of the year, with a small increase each time upon half that amount. If coarsely ground, it will not be found effectual in its application to the leaves; and if used either in drills, or as a

common top-dressing, at least the full quantity just mentioned must then be applied*.

As lucerne and sainfoin are the only artificial grasses generally cultivated, which remain for a number of years upon soils adapted to their growth, it has, however, been found, in many instances, that by forcing a heavy crop in the first year, by the use of six bushels per acre, and repeating that quantity in the third or fourth, the plants have shortly afterwards become so exhausted as to admit of no alternative but the plough. It, therefore, merits consideration, how far the obtaining an increase of those crops, by such means, within a short period, is more advantageous, than by the application of only two or three bushels per acre, and afterwards repeating the same quantity at a future stage, to leave them longer in the ground; but it is a point which depends in a great measure upon the local circumstances of the land, or the particular resources of the farmer, and must be left entirely to his own judgment.

With respect to the *permanency of gypsum* as a manure for artificial grasses, it has been stated, in those cases in which its beneficial effects have been proved, that sainfoin dressed with it did not materially decline until the fourth crop, and on sowing five bushels more per acre, it recovered, and became as productive as before, yielding, on a thin soil, about a load and a half; whilst another patch, dressed partly with soot, became so weak as to be scarcely worth mowing. Its durability, when applied to lucerne, has been found to produce very fine crops during five years; when the natural grasses appearing to gain ground, five bushels more per acre were again laid on, which forced such a smothering crop, that the grass could no longer make head until after the third cutting, when it afforded, with the last shoot of the lucerne, a very fine crop of rowen. Although much difference is observable in the results of the various experiments which have been recorded respecting the effects of gypsum on artificial grasses, yet there are none with which we are acquainted, in which its application has not been successful when applied as a top-dressing to the plants, conducted with due precaution, and not deranged by violent rain, or other accidents arising from the weather. In this we are borne out by the testimony of Dr. Fothergill of Philadelphia, as well as by that of several eminent American farmers, mentioned by Mr. Parkinson, and supported by the more recent treatises on the subject, written by Mr. Russell, and Professor V. Thaër †. We, therefore, do not hesitate to recommend it as an effectual means of promoting their growth, and more especially that of red clover, provided the soil be at the same time tolerably covered with plants; though, in confining that opinion to top-dressings applied to the leaves, as being the most decidedly effectual mode, yet, as there are numberless instances of its success when drilled along with the seed, we do not mean to preclude its being laid upon the land at the time of sowing.

The trials which have been hitherto made of its *application to corn crops* seem to prove that it does not operate directly on grain; but they are unanimous in showing that the stubble of a clover-ley which has been manured with gypsum, when afterwards ploughed up, produces a far better crop—especially of wheat—than when it had been omitted. There is, however, strong reason to suppose that this should be rather ascribed to the

* See Essay on Soils and Manures, Anon. pp. 90, 97; Annals of Agric., vol. xvi. p. 184; xvii. p. 297.

† See an Essay by Dr. Fothergill, F.R.S., in the Comms. to the Board of Agricul. vol. vi. art. 49. Practical Observations on Gypsum, as a Manure, by Richard Parkinson. A Treatise on Practical and Chemical Agriculture, by Joseph Russell, chap. x. Principes Raisonnés d'Agriculture, par V. Thaër, 2nde édit., tom. xi. § 654 à 661.

luxuriance of the clover—no matter in what way that may have been occasioned—than to the direct application of the gypsum; for it is well known that crops of wheat, and indeed of most grain, always succeed in proportion to the growth of the previous clover, which is not improbably occasioned by its keeping the ground moist, and preventing its exhalation by the sun. We have, indeed, heard some recent instances of its having been used as a top-dressing to wheat in the spring—in some cases with great success, and in others without any apparent effect; but this may perhaps be not unjustly attributed to its having fallen, in the former case, upon the shoots when they had been moistened by the dew, which thus enabled them to retain the powder, and in the latter, by its having been either washed off by rain, or dispelled by the winds.

Its direct *effect upon crops of pulse* has not been sufficiently ascertained to enable us to speak of it with precision. Pease, indeed, have been known to succeed wonderfully after sainfoin which had been previously manured with gypsum, but they generally flourish in chalky soils, in which sainfoin is also commonly sown. It has, however, been remarked that both pease and beans frequently become hard in boiling, which has been attributed to the temperature of peculiar seasons, and, above all, to rain, which has impeded the usual course of harvest; this, however, has been found to be a mistake, for it has been shown that this defect is due either to the soil being naturally impregnated with gypsum, or to its having been laid upon the land as manure *. As an instance both of its effect and of the prejudice which many people entertain against it as a manure, an anecdote has been related of a gentleman who, having recommended its use, ordered his servant to spread a small quantity of it secretly upon an adjoining piece of sainfoin, belonging to an old farmer who vehemently decried it. The crop proved surprisingly abundant on that spot to which the gypsum had been applied; but upon discovering its occasion, the old man, instead of profiting by the circumstance, grew peevish, and wondered why his neighbour should have taken the liberty of spreading this new-fangled manure over his sainfoin, which, for aught he knew, might do more harm than good. The laugh, however, going against him, he determined to get rid of it by breaking up the sainfoin and sowing pease; when, behold! they also rose in judgment against him so evidently on the gypsumed part, that he was constrained, though reluctantly, to acknowledge that 'it seemed good stuff:' yet he was never afterwards known to lay a bushel of it upon his farm.

Of its power, *when applied to bulbous roots*, the accounts are equally deficient; except, indeed, that Mr. Parkinson has furnished different statements of its application, on his own farm in America, to turnips, both sown along with them in the drills, and spread over the plants when they got into rough leaf; in each of which the superiority of the crops on those portions of the land on which the gypsum had been laid, was so evident in quantity, that in some patches spread with it in squares, in order to mark any difference that might arise, 'the ground was checkered like a floor of black and white marble, and the quality was so much more sweet and juicy, that none in Baltimore market sold for so much, or so readily †.' He however admits, in another of his works ‡, that a small quantity of

* Bulletin des Sciences Agricoles, Février, 1828. The fault may, however, be corrected, by throwing a small quantity of carbonate of soda into the vessel.

† Practical Observations on Gypsum, pp. 72—90.

‡ Survey of Huntingdonshire, p. 210. Its use has also been recommended in the Survey of Hampshire, by Mr. Vancouver, who resided long in America, and states

compost dung was laid on along with the gypsum, but 'where no compost was applied, the gypsum by itself was of no avail;' and in some other trials made in this country, when laid upon alternate lands of oats and turnips, it has produced no visible effect *. In his other experiments on potatoes and onions, as also on carrots and cabbages, and on various crops of white corn, no perceptible difference could be observed in the application of gypsum; except that, in one instance, 'the plastered rows of potatoes were rather worse than the others;' and that, 'on old land newly ploughed up, but not pared and burnt, the gypsum was found to act as a corrector of the soil, and thus to give more grain and less straw.' Mr. Parkinson, indeed, attributes its chief powers to consist in its quickly cementing, and thus preventing the heat of the sun from exhaling the moisture or nutritious quality of the manure; by which means the plant, being kept moist at the root, consequently grows well, and quickly gets a shade from its own sprouts †. This would, however, tend to prove that its application would be serviceable to all crops in dry weather: an opinion which is not borne out by what has been already stated of its effects.

Such are the chief points regarding its *practical application* to which some objections have been made. 1st. As tending to render the land stiff under the plough. 2nd. As exhausting the soil by forcing vegetation. 3rd. As being confined in its effects to particular crops, and becoming, perhaps, prejudicial when those are followed by others of a different nature. To which it may be answered:—

1. That the increased tenacity of the soil can only be occasioned either by some extraordinary excess in the application of the gypsum, or by its being laid upon heavy clay, to which it is unsuitable; but, if applied to light porous land, unretentive of moisture, the firmness of texture thus imparted would become a real advantage.

2. That this stimulative property is common to every substance that merits the name of manure. That, although gypsum may not be possessed of any nutritive quality in itself, yet, if the land be properly dunged, or otherwise supplied with a sufficiency of other putrescent manure, or of nutritive compost, to support the increased powers of vegetation,—and which, in common prudence, should never be neglected,—the soil will not, if discreetly managed, suffer any diminution of its accustomed fertility, but will be improved by the large addition made, through the greater luxuriance of the green crops, to the size of the dunghill.

3. That its beneficial effects being confined to some peculiar species of crops, is no real disadvantage; for, when applied to those of a different kind, it has not, in any known instance, been found prejudicial. Its powers appear, indeed, to apply more to the specific crop on which it is spread, than to the state of the soil; and when it has been laid in various quantities—from two bushels to two-and-thirty—on crops to which it is inappropriate, it has been found in all cases wholly ineffectual ‡.

It has been assigned by Sir Humphry Davy, in the *theory by which the operation of gypsum is governed*, as a general standard for its application,

that his knowledge and experience of it justify him in the opinion that it is a good top-dressing for grass, and adapted to the growth of turnips, though the quantity spread by himself never exceeded 2 bushels an acre.—p. 347.

* Survey of Derbyshire, vol. ii. p. 448.

† Survey of Huntingdonshire, p. 210.

‡ Mr. Parkinson states that he has applied it in all those proportions—namely, 32, 16, 8, 4, and 2 bushels an acre upon the same land, a portion of which was left without

that it is the most beneficial to those plants which always afford it on analysis: thus, the ashes of lucerne, sainfoin, rye-grass, and clover, contain considerable proportions of gypsum; but only a very minute quantity is to be found in crops of corn, pulse, or turnips. It is, therefore, essential to the vegetation of the former; and land which has grown tired of clover, may be restored by being dressed with it*, or with peat ashes†, some species of which hold a large portion of gypsum. But when the soil already contains a sufficient quantity of this substance for the support of the cultivated grasses, he considers that its application to them, or even to natural pasture, cannot be advantageous; for plants only require a certain portion of manure, and an excess may be detrimental‡. The reason why its application to soils is not always efficacious is, probably, because it is furnished by the common course of culture to most well cultivated land in sufficient quantities for the use of the grasses, and perhaps to an excess beyond what other crops require for their growth; for although this may not be apparent to the farmer, it is contained in stable dung, and in the dung of all cattle fed on pasture. A certain portion of it may also be discovered, upon analysis, in the natural composition of most soils§.

It has been said, by Kirwan, to accelerate putrefaction in a higher degree than any other known substance; but this has been shown by some experiments of Sir Humphry Davy to be incorrect, and it, therefore, cannot be supposed to afford any direct nourishment to plants, either by the corruption of animal remains, or the decomposition of manure‖. It has been very generally supposed that, as sulphuric acid has a great attraction for water, gypsum acts by its power of attracting moisture from the atmosphere; thus cooling the air in summer, and being more efficacious to dry, sandy soils, than wet clays. It has even been confidently stated, that the dew has been known to stand two hours later in the morning upon plants which had gypsum spread upon them than upon others on which there was none¶. This, however, has been also contradicted by Sir Humphry Davy, who considers the argument in its favour to be comparatively insignificant; for, when combined with water, it retains

gypsum, the whole field equally manured with compost dung, and afterwards carefully sown with rye; but when the crop was reaped, there was not the slightest difference perceivable. The experiment was repeated in a following year upon barley and oats, and the result of each was precisely similar; and as to white crops of any description, it seemed, from his own experiments, to have no effect at all upon them.' —See his Practical Observations on Gypsum, pp. 81, 85, and 95.

* Upon an analysis of two fields of different land, one growing good crops of red clover, the other growing them partially or wholly ejecting the plant, the results have invariably shown that those soils which grew the best crops of red clover were those that contained the most gypsum.—Russell on Pract. and Chem. Agric., p. 119.

† See the following chapter. ‡ Elements of Agricultural Chemistry, p. 17.

§ Sir H. Davy analyzed four different kinds of soil; one, a light soil from Norfolk, another, a clay, bearing good wheat, from Middlesex, the third, a sand from Salop, the fourth, a clay from Essex. He found gypsum in all of them; and in the Middlesex soil it amounted to nearly 1 per cent. Lord Dundas also informed him, that having tried gypsum, without any benefit, on two of his estates in Yorkshire, he was induced to have the soil examined for gypsum, and it was found in both soils.—Elem. of Agric. Chem., 4to., p. 291.

‖ He mixed some minced veal with $\frac{1}{100}$ part of its weight of gypsum; and also exposed some veal without gypsum under similar circumstances. No difference appeared in the time when they began to putrefy; and the completion of the process seemed to be most rapid in the case in which there was no gypsum. Other similar mixtures were also employed, in some cases with larger, and in others with smaller, quantities of gypsum, and pigeons' dung was, in one instance, used with flesh; but the results were, in every instance, precisely similar.—Ibid., p. 208.

¶ Parkinson on Gypsum, p. 78. Blakie on Mildew, 2nd edit., p. 35.

that fluid too powerfully to yield it to the roots of plants, and its adhesive attraction for moisture is inconsiderable *: yet, though thus opposed by scientific reasoning, the experience of farmers inclines to the support of the opinion already stated. It is even thought by many people that, when sprinkled over the leaves of plants in a damp state, the paste which it thus forms upon them must prove destructive to the propagation of many insects, and would probably prevent the fly in turnips; but that supposition has not been confirmed by experience. It has been likewise asserted, that its fertilizing powers are destroyed by the effects of sea air, and much of its failure in many parts of England has been attempted to be accounted for upon that principle; but this is in direct opposition to the trials already mentioned to have been made in Kent, and it has been found to answer in Norfolk when applied to land within two miles of the Northern Ocean †.

The American farmers lay it upon land newly reclaimed from the forest: it may, however, be doubted whether gypsum contains any inherent property by which it can improve the soil, unless through the means of its fertilizing powers upon the peculiar crops to which it is appropriate, and there is reason to believe that, even upon these, its effects will be comparatively trifling if ploughed in. There cannot, however, be any question respecting its expediency when applied as a top-dressing to artificial grasses at that period of the spring when the plants throw out their first leaves, if spread in portions of not less than four bushels of the finest powder, so equally sprinkled that every leaf should get some, and in weather that is perfectly serene and close. We have afforded the subject more attentive consideration than some persons may suppose it to merit, for it cannot be denied that, in consequence of the disappointment which it has occasioned to many who have tried it without being aware of its peculiar nature, the use of gypsum throughout England has been very generally discontinued; but on a careful review of the very contradictory opinions entertained regarding its effects, we are persuaded that no dispassionate and intelligent farmer can entertain any doubt of its being rendered a source of very important benefit, when used with due discrimination of its powers, and judgment in the mode of its application. We therefore strenuously recommend it to experiments upon a moderate scale; for even should it not be found in the immediate neighbourhood, the cost and carriage are so trifling that a sufficient trial can be made for a few shillings; and we should say that no man who grows a single acre of clover should fail to satisfy himself regarding its real properties. If successful, it may become the means of material improvement upon light loams, and poor chalky soils, which require amelioration through the manure afforded by green crops, as well as to land which, though in better heart, may have lost the power of repeating the production of clover so often as it might be found profitable. No one can justly assert that it is not worth the trial; and, *even if unattended with good effect, it can do no harm.*

* To determine this fact with precision, an ounce and a half of gypsum in fine powder was exposed to the air during three foggy nights, and afterwards carefully weighed, when it was found to have given not quite half a grain in addition.—Comm. to the Board of Agric., vol. ii. p. 376, note.

† Blaikie on Mildew, 2nd edit., p. 36.

Chapter XV.

MINERAL MANURES *continued.*—ASHES—SOOT—SOAPERS' WASTE.

ASHES

Of every description, including soapers' waste, though not all falling strictly under the character of fossil substances, and, indeed, being partly derived from the vegetable kingdom, yet, partaking in a great degree of the same calcareous nature as those of which we have already treated, may also be allowed to rank together under the general denomination of mineral manures. Those of coal, wood, and turf, when used for domestic purposes, are, in almost all country places, mixed up by the consumers with the dunghill, and, unless they form an unusual proportion of the heap, occasion but little sensible difference in the properties of the manure; but, when applied alone, as top-dressings upon grass, they both strengthen the herbage, improve its quality, and encourage the growth of white clover; they are also generally used for many other crops, both of corn and artificial grasses, but chiefly upon clays and heavy tenacious loams.

The *ashes of coals*, and *cinders*, have, indeed, the very perceptible effect of loosening as well as stimulating those soils, and when they can be procured in sufficiently large quantities, in the neighbourhood of great towns and manufactories, they are also ploughed in with great advantage, to the extent of 50 or 60 bushels, or even more of the latter, per acre.

Those of wood, which forms the chief firing in the interior of this country, are also largely employed by many farmers, who contract with the cottagers for all the ashes they make; drawing home for them in return their faggots. The manure thus procured, being a powerful alkali, has a very considerable effect in correcting any acidity that may exist in the soil, but is, in almost every instance, employed without any distinction respecting the sort of timber from which it is obtained, though, as the trees contain very different qualities, they necessarily yield ashes corresponding, to a certain extent at least, with their original character; and were they classed, and farmers made acquainted with their relative properties, they would be much better able to judge of the due proportion of ashes which it might be expedient to apply to the ground *.

* It is a well-ascertained fact, that the closer the texture of the wood, and the harder and heavier it is, the greater portion of vegetable alkali it will be found to contain. Thus, by a brief analysis extracted from the Essays of the Bishop of Llandaff trees may be classed, according to the value of their ashes, as follows:—

FIRST CLASS.	SECOND CLASS.	FOURTH CLASS.
Oak	Elm	Birch
Ash	Maple	Alder
Sweet Chestnut	Hornbeam	Sycamore
Yew	Whitethorn	Poplar
Beech		Hazel
Pear	THIRD CLASS.	Elder
Crab	The Pine and Fir Tribes	Sallow.
Blackthorn		
Broom		

It therefore necessarily follows, that where the kind of timber which has been consumed can be ascertained, the proportion of ashes to be applied per acre ought to vary accordingly; for, if six loads of the best and purest ashes from oak be sufficient, ten or twelve may not be more than equivalent to them when produced from hazel, alder, or sallow; and by the same rule, if ten or twelve loads of oak-ashes were to be sown,

A similar remark will apply to the *ashes procured from furze*; for these are found to possess different degrees of strength, in proportion as they are burned, either in the brick-kiln, the lime-kiln, or the oven. Thus it is well known to most farmers that, in preparing chalk or limestone for burning, in most country kilns, these faggots are very generally used, and being placed in the centre of the pile, as the heat increases, and the stones get into a state of calcination, the action of the fire soon affects all the smaller and looser parts of the stone, which fall down to the bottom, and mix with the ashes. Inasmuch, therefore, as burnt lime possesses a greater stimulus than burnt clay, we may conclude that in the same proportion this refuse from the lime-kiln will be more valuable than that from the brick-kiln; while the ashes produced by the baker's oven must be far superior to either, and may rank in much the same class as those obtained by the burning of weeds*.

The *ashes of burnt straw* have also been found beneficial by many intelligent practical farmers, from some of whose experiments we select the following instances. Advantage was taken of a fine day to fire the stubble of an out-field soon after harvest, the precaution having been previously taken of sweeping round the boundary to prevent injury to the hedges. The operation was easily performed, by simply applying a light to windward, and it completely destroyed every weed that grew, leaving the surface completely covered with ashes; and the following crop, which was wheat, produced full five quarters per acre. This excited further experiment, the result of which was, that in a following season, the stubble having been partly ploughed in according to the common practice, and partly burned, and the land sown with wheat, the crop produced eight bushels per acre more on that portion which had been burned, than on that which had been ploughed-in. The same experiment was repeated, on different occasions, with similar results; and a following crop of oats having been laid down with seeds, the clover was found perfectly healthy, while that portion on which the burning of the stubble had been omitted, was choked with weeds †. To which we must add, the experiment on the efficacy of burnt straw, as stated in p. 248 of this work, which, though not supporting the superiority of corn crops over those manured with dung, yet, on those two, in which alone it could have been supposed to have taken effect, it bore a very near degree of equality. It must, however, be recollected, that if intended to have a decided effect, the stubble must be left of a considerable length, which will occasion a material deficiency of farm-yard manure; though the advantages will be gained of saving the cost of moving the stubbs, the seeds of weeds and insects will be considerably destroyed, and the land will be left unimpeded for the operation of the plough.

On the wolds of Lincolnshire, the practice of not only burning the stubble, but even the straw of thrashed grain, has been carried, in many cases, to the extent of four to six loads per acre; and, as it is described in the Report of the County, has been attended, in all those instances, with very decidedly good effect. It is even said to have been found superior, in some comparative trials, to yard-dung, in the respective rate of five tons

because it may have been the custom to use that quantity of hazel, &c. the effect might be found, in a dry season, to burn up the crop. See Malcolm's Comp. Modern Husb. vol. ii. p. 178.

* Malcolm's Comp. of Mod. Husb., vol. ii. p. 184.

† Survey of the East Riding of Yorkshire; Communications to the Board of Agric., vol. iv. p. 130.

of straw to ten of manure! Although placing implicit faith in the results thus stated, we cannot, however, but feel strong doubts of the expediency of the practice; for we should hesitate to recommend any measure that tended to reduce the quantity of farm-yard manure—the application of which is always certain and always durable, whilst the most decided advocates for the burning of straw are compelled to admit that its effects are but transitory. Some intelligent farmers, indeed, consider the benefit to arise more from the effect of the fire in the destruction of weeds and insects than from the small quantity of ashes that are produced, and its chief value must be supposed to consist in the superior degree of cleanness which it imparts to the land*.

In this country we are accustomed to regard *turf* as the mere sods cut from the surface of marshes in dry weather, and afterwards burned as fuel, for which purpose it is, in many parts, very generally employed by the peasantry. The quality of ashes thus produced must depend, like every other kind of vegetable manure, upon the nutritive portion of the matter contained in them, and will be treated of in a future chapter, under the head of Paring and Burning; but in most parts of Scotland, and throughout the interior of Ireland, the term is applied to *peat-moss*, which is found in many districts in quantities which appear inexhaustible, and seem to consist in the accumulated remains of aquatic plants, heath, fern, and other vegetable matter, brought into a state of decomposition through the effects of stagnant water: it is indeed so retentive of moisture as to retain it in a manner similar to sponge. It exists in deep pits, from which it is dug in the summer, then cut into squares, either by the hundred, or by measure, and exposed to the sun and air until it becomes dry; but when prepared for farming purposes, upon a large scale, it is burned, either in kilns or in large heaps, expressly for manure, and the most usual mode is by means of the slow combustion chiefly of the lowest stratum of the peat, as in that part the fibres of the matter which it contains are most decayed. It is also found in many parts of England: but the ashes in the highest repute are those made at Newbury, in Berkshire, the process of manufacturing which, as it will serve with very little variation for every kind throughout the kingdom, may be thus detailed.

The stratum of this *Newbury peat* lies at various depths, though generally at about five feet below the surface, and of the thickness of from one foot to eight or nine, the ground underneath being very uneven, and mostly gravel; that which is above commonly consists of a good meadow soil. The hills at each side consist chiefly of chalk, easily dissolvable by heavy rain, which washes it off the ridges, down to the low ground, where, mixing with the floods, it is floated over the meadows, and deposited in the peat; the ashes, therefore, differ from those of most other districts, in the quantity of lime which they contain, to which their extraordinary valuable qualities have been chiefly attributed. The peat varies in colour, but the blackest is reckoned the best, and the most esteemed ashes have a reddish hue; those which are pale and whitish, being of a species of earth compounded of clay, and termed 'clob,' which, though burned for manure, lies above the true peat, and is of a different and very inferior quality. This being removed, the real peat is cut, with a peculiar kind of spade, into long pieces, about 3½ inches broad every way, after which it is conveyed from the spot where it is dug, in wheelbarrows, to a short distance, where it is spread upon the ground in regular rows until it be dried by the sun and

* Survey of Lincolnshire, p. 304.

wind. It is thus cut down until the gravelly bottom is reached, if it can be sufficiently drained; but although persons are employed to pump the water, that cannot be always completely effected.

After having been thus laid to dry during about a week, the pieces are turned, and this being three or four times repeated, a small round heap is made in the middle of the place where the peat is spread, and in the centre some very dry peat is put, which being lighted, the fire communicates slowly to the rest of the parcel. When it is completely lighted, an additional quantity is put upon the heap, and this is continued till the whole is consumed, which generally occupies one or two weeks, and sometimes still longer, as quick burning is not approved of, and the rain seldom penetrates deep enough to extinguish the fire. The heaps are commonly of a circular form, and rather flat at top: at first very small, but gradually increasing, until it sometimes becomes two or three yards deep, and six or seven yards in diameter. According as the peat is more or less dry, or contains more or less essential oil, or, as it is termed, is more or less fat—according as the weather is favourable or otherwise, and in proportion as the heaps are more or less large, just so much a longer or a shorter time will it take to consume. A fire regularly kept up, but burning by slow degrees, will retain more of the vegetable alkali in it than a more quick one; and in proportion to the heat of the fire the same quantity of peat will produce more or less ashes: thus it has been stated by Mr. Malcolm that, in the parish of Frimley, in Surrey, three loads of dried peat, which is about the size of the usual heap, will yield from 6000 to 7000 bushels, which have been sometimes known to yield 2400 bushels of good ashes*; though the peat is generally so reduced in measure by combustion that the ashes seldom equal one-fourth of its original bulk. The ashes being riddled, are then conveyed away in covered carts, and put under sheds to keep them from the wet until they are wanted for the land; for if kept under cover and dry, they are infinitely more strong and active than those which have been made some time, and have been exposed to the weather: the fresher they are when used, therefore, the better. The usual time of applying them is in March and April, in the proportion of twelve to fifteen bushels per acre, according to soil and crop, as too large a quantity would be injurious, though, on meadow land, twenty bushels are often laid with advantage; and, when not used as top-dressings, they are commonly spread at the same time as the seed is sown, though for grass many people prefer the autumn. For corn crops, however, they are not in much estimation; but on turnips they are said to assist in checking the fly, and they are supposed to increase clover nearly a ton of hay the acre beyond what it would have yielded without them: their effect, however, is not calculated to last more than a couple of years, but they are of such benefit to that crop, and to the succeeding wheat, that when a tenant quits a farm on which ashes have been laid in the preceding year, it is usually customary to allow him one half of the expense. The price, at Newbury wharf, varies according to quality; but the best is generally sold at about sevenpence per bushel. One man, with a double cart, can sow several acres in a day, but the weather should be perfectly calm, or they will be unequally dispersed by the wind †.

In a series of experiments, for a long time carried on upon these ashes, they were found to contain from one fourth to one third part of gypsum,

* Agriculture of Surrey, &c., vol. ii. p. 193.

† Surveys of Berkshire, p. 359, and Appendix, No. 111; of Hertfordshire, p. 166; and of Middlesex, 2nd ed. p. 368.

and even a larger proportion of that substance was discovered in some burned in the neighbourhood of Stockbridge, in Hampshire. The other constituent parts consisted of a little iron and common salt, with various quantities of aluminous, calcareous, and siliceous earth *; and the analysis of some very celebrated peat-ashes, brought some years ago from Holland, in which country and Flanders they are most extensively used as manure, as made by Professor Brande, showed them to contain, in 100 parts,

Of Siliceous earth	32	parts.
Sulphate and muriate of soda	6	,,
Sulphate of lime	12	,,
Carbonate of do.	40	,,
Oxide of iron	3	,,
Impurities and loss	7	,,

from which we may readily conclude the great degree of advantage with which they must be applied to sour meadows, as well as to every species of artificial grass.

These *Dutch ashes*, indeed, as we learn both from Sir John Sinclair's account of the agriculture of the Netherlands, and from another statement lately published regarding their use †, are very extensively used throughout Flanders, in the following manner:—

In March the wheat is worked with the hoe between the rows, and sown with clover, and in May the wheat is hand-weeded. The crop being reaped, the land is harrowed in the following spring, and then the ashes are spread by hand upon the clover, in calm and hazy weather, at the rate of 18 to 20 bushels per imperial acre. They are also laid on pastures and on wheat in March and April; on oats and beans in the beginning of May; and on rye in October and November. Their chief employment is, however, for green crops: it having been found, on comparative trials in Flanders, that top-dressings on clover, where the ashes were used, were much earlier, heavier, and superior in every respect to those which had undergone a top-dressing of horse and cow dung. One of the best proofs of their usefulness, indeed, is the fact, that while our crops of clover in this country very often fail, such an instance but rarely occurs wherever they are used in any part of Holland. Besides improving the crop, they are also useful in preventing the injuries arising from insects, and when applied to pasture they are highly serviceable in the destruction of moss. To numerous individual instances of their beneficial effect, Sir John Sinclair, indeed, adds the public declaration of eighty-three practical Flemish farmers, to the effect that 'they know by experience, that when clover is not manured with Dutch ashes, at the rate of 25 cuvelles per hectare (equal to 19 bushels per acre), the following crop is very bad, notwithstanding any culture that can be given to the soil; whereas they always have an excellent crop of wheat after clover, and, doubtless, in proportion to the quantity of manure above-mentioned being used ‡.' The farmers who have subscribed this declaration must have been deeply impressed with the importance of these

* Sir H. Davy's Elem. of Agric. Chem., p. 298.

† Mitchell on Dutch Ashes as Manure. Quart. Journ. of Agric., No. xxi.

‡ Two other very eminent farmers state, 'that no manure, though it were to be given in greater quantities, and at more expense, would equal it in strength. That he sows it at the rate above-mentioned, and always obtains two great crops of clover, besides pasturage afterwards; and that wheat after clover, manured with Dutch ashes is the most certain crop of any, as well as being unmolested by the wire-worm.' They have also been recommended by an eminent agriculturist, F. L. W. Brakkel, in a work lately published at Utrecht, his alternation of crops being clover, potatoes, rapeseed, pease, wheat, clover, and oats.

ashes; for, besides being brought through the canals from Holland, they must in most cases have been afterwards carried from forty to fifty miles by land carriage. They can be imported from Rotterdam, and have been delivered at Leith at 3*l.* per ton, including all charges; the bushel of the best sort, which are black and heavy, weighs about 40 pounds, and the ton containing 56 bushels, the cost, at the above rate of manuring, will be 20*s.* per acre.

SOOT.

The soot produced by different species of fuel is subject to the same difference in quality as those substances from which it is derived. Thus the pit-coal brought from Sunderland and Newcastle contains a much larger quantity of bitumen than that which is found in Staffordshire and most other parts of the interior, which burns to a white ash and exhales a considerable portion of sulphur; while that of the various kinds of wood and peat, when burned, also manifest a proportionate variety of properties. It would, however, be nearly fruitless to enter into any detail of its peculiar efficacy, both as not being of sufficient importance, and as having been ascertained by the following very minute experiment personally made by Mr. Malcolm, which speaks more effectually to a farmer than all the chemical definitions that can be offered; though it may be observed that the result coincided precisely with a very scrupulous analysis *.

The experiment was made on a piece of drilled wheat, of the extent of half a quarter of an acre, sown upon a potato-fallow well manured for that crop, and afterwards dug with the spade about 18 inches deep, and marked into beds of 5 feet wide; four rows being sown very thin in drills made with the hoe at 1 foot distance, and only 2 quarts of seed being used to each bed. It was not sown until the 14th of December, and, from the lateness of the season, none of it vegetated before the frost set in; but as soon after Christmas as that was gone off it made its appearance very regularly, and on the 22nd of February every bed was carefully hoed, each being numbered and top-dressed as follows:—

No. 1, with soot from coals. 2, do. from wood. 3, do. from peat and turf.	The quantity of soot applied to each being 1 bushel.
4, do. from coals. 5, do. from wood. 6, do. from peat and turf.	Do. half a bushel.

The usual course of management was pursued until harvest, when the whole crop was in admirable order, but the first three numbers were in height nearly a foot above the rest, stronger in proportion, free from blight or mildew, and produced a finer grain. The amount was as follows:—

	bl.	pk.	qt.		bl.	pk.	qt.
No. 1 . .	1	3	6	No. 4 . .	0	3	7
2 . .	1	1	4	5 . .	0	3	3
3 . .	1	2	5	6 . .	0	3	0

The entire crop was thus at the rate of 5½ quarters per acre; but the soot was accurately collected from fires burnt in the house, while that commonly sold by the chimney-sweepers is in general mixed with dust and

* Mr. Malcolm's experiment was extended to other kinds of top-dressings, consisting of brick and lime rubbish, with mixens of dung, road-scrapings, and other substances an account of which he has stated, and which were found inferior to the soot.—See his Compend. of Mod. Husb., vol. ii. pp. 167, and 157 to 169.

other trash, which lessens its power: their measure, too, is generally short, it being concluded by the dealers that the soot is taken at once to the field, without being remeasured; but the fraud is worth guarding against, for, although it varies greatly in price, it is not usually to be obtained in London for less than from sixpence to sevenpence-halfpenny per bushel, strike measure; while at York, it is now five; at Hull, four; and at Manchester, only two shillings per bushel, corn measure, and it has been recommended to be spread in the following proportions:—

Upon strong loams—	for wheat .	from 40 to 45 bushels.
	seeds and pasture .	20 to 30
Upon light loams—	for wheat, barley, and turnips	30 to 35
	seeds and pasture .	20 to 25
Upon chalky loams—	for wheat, barley, and turnips	30 to 40
	seeds and pasture .	20 to 25

but the latter is, upon all soils, the more common quantity.

When labour is at 12*s.* a week, the price of sowing is generally one halfpenny the bushel, sometimes with beer; and at this rate an active man has been known to earn from 3*s.* to 4*s.* per day, sowing from 70 to 80 bushels, and upwards. The soot being previously brought in sacks, the sower fills his scuttle, and scatters the dust by putting his hand fully expanded into it, and spreads it—generally walking backwards—as wide as possible. The operation is however more generally performed by chimney-sweepers than by the farmer's people; for, let the air be ever so still,—which is, indeed, the only proper time in which to spread it,—the lighter particles will hang in the air, and settle about the sower in a manner that will not only soon make him as black as itself, but, entering his eyes, nose, and ears, causes extreme pain through its causticity. Those who are not accustomed to it should, therefore, cover their face with a piece of gauze, as if they were working among hot lime.

Soot is usually sown upon wheat if it be weak, or if the yellow cast which it sometimes assumes in the spring shows it to be sickly; in which cases it will improve the colour and strength of the plant, which will then tiller out and cover the ground with a great number of new shoots. Upon barley it is sometimes sown with the crop, and at other times a fortnight after; but it should never be deferred later, and if possible, should be spread in April. It is also occasionally applied as a top-dressing to clover and other artificial grasses, though it seems better suited to rye-grass than to any other species, for, when both that and clover have been sown together, and that the field has been dressed with soot, the former has become so rank as to completely overtop the latter. One of its most common uses among farmers is, however, for turnips, either sown along with the seed, or, more usually, immediately after the plants appear, as it is so acrid and bitter as to become injurious or disgusting to insects, and has therefore been found very efficacious in preventing the ravages of the fly, as well as that of the wire-worm. The best time to sow it is on the evening of a cloudy but calm day, when there is an appearance of rain, for if the weather be hot and dry, its volatile parts are dispelled, and it becomes of no service to the crop.

Some farmers recommend its being mixed with an equal quantity of quick-lime, and double that quantity (of those two combined) of fresh loam; the soot and loam to be regularly amalgamated by passing the latter through an upright screen, as practised by bricklayers, by which means the lumps will be either kept back, or broken and passed through

* General Report of Scotland, vol. ii. p. 543.

it; and after remaining in this state during almost a fortnight, the lime should then be added by turning the heap and mixing all together; after which it will, in a few weeks more, become fit for use *. The materials thus enumerated are all good, and doubtless will prove serviceable to those soils to which they are adapted; but we are not sufficiently acquainted with the experiments which have been made upon this species of compost to speak of its effects with any degree of certainty; and we doubt whether the most beneficial mode of applying the soot will not be still found to consist in spreading it in a dry state, without any preparation, as a top-dressing. As an application in that mode, to such crops as we have mentioned, it will be found useful, when used in moderation, upon soils of every kind; but if intended to be applied as an improvement to the land, it will be of very little benefit after the first year.

SOAPERS' WASTE.

The use of the ashes produced by the manufacture of soap—the refuse of which is termed *soapers' waste*—has been much recommended as manure; and it has been supposed that its efficacy depends on the proportion of saline matter which it contains: this, however, is very minute, and depends upon the sort of alkali employed by the soap-boiler, two kinds of which are chiefly used—namely, kelp and barilla—which are much more effective than that which is the refuse of common pot-ash. These substances are both derived from the calcination of marine plants, of which the sea furnishes an abundance in a peculiar nature of weed, particularly on the western coasts of Scotland and Ireland, where many thousands of the poor inhabitants obtain their chief support from securing and burning the former. The species known as barilla is, however, chiefly procured from the island of Teneriffe and some parts of the Mediterranean; the difference between the two, in 100 parts, having been shown, by the analysis of Sir Humphry Davy, to be as follows:—

BARILLA.

Carbonate of lime	76	Total of calcareous matter exclusive of gypsum	91
Quick-lime	15		
Gypsum			5
Common salt			1⅓
Carbonate of soda			1¼

KELP.

Calcareous matter, such as that for barilla	94
Gypsum	3
Soluble saline matter and carbonate of soda of nearly the same proportion.	

The alkali contained in kelp, however, often differs from 1 to 6 per cent.; but the manufacture has been almost entirely abandoned since the late duty on barilla imported from abroad has been recently taken off, and as it is not probable that it will be renewed in this country for the mere purposes of manure, the latter is the only quality that need be considered.

* On the deplorable condition to which a numerous class of our peasantry has been reduced through this act of the legislature, it is not our intention to offer any remark; but we may suggest, that it becomes a matter of much importance to ascertain whether the kelp thus formerly employed may not be still usefully applied as manure. Some reports presented to the Highland Society would lead to that conclusion: 30 tons of sea-ware are required to produce 1 ton of kelp, which is said to have equal power upon the land as the weed in its wet state. The manufacture of a ton of kelp has, indeed, been calculated to amount to 3*l*. 15*s*.; while the weed can be cut, carried on shore, and dried, for about 25*s*. to 30*s*.; but when in the latter state it is only applicable to the ground at a short distance; and when manufactured it is as portable as any species of ashes. It is also probable that the proprietors of the kelp shores and the manufacturers may find it expedient to lower their rate of charges, so as to render it available to the use of farmers.

The other ingredients in the common kinds of soap are lime, with oil or tallow; but as the oily particles are wholly extracted in the manufacture, the waste can only be considered as a calcareous manure, and consequently will be only found efficacious on such soils as are deficient in that substance, or in those which abound largely in undecomposed vegetable matter, upon which it acts powerfully. It must, however, be observed that the waste from hard and soft soap is materially different in its qualities, for there is a greater proportion of alkaline matter used in the manufacture of the former than of the latter: thus, in examining the ashes that are produced from soft soap, they will be found light and spongy, which may probably arise from potash being used in its composition, instead of barilla; while the refuse of hard soap is more dense and firm, and much stronger than the other in its effects upon the ground. Farmers should therefore inquire, before they use it, which sort is made by the manufacturer, and use it accordingly.

On strong, cold, and wet soils, or low spongy meadows overrun with rushes and similar weeds, as well as on peat-moss and other land that is rank with vegetation, it is found highly beneficial; on loams it is also an admirable manure, and in a rainy season its effects are quickly visible, for its hot nature is probably tempered by the moisture: but its application is not advisable on calcareous soils, or on light, dry, and burning sands, and it is generally thought preferable to lay it upon pasture than upon arable ground. When laid upon the latter, however, it should be harrowed in previously to the sowing of the seed; or, if ploughed into the land, the ashes being of a very heavy nature, the soil should be turned in with a shallow furrow, and should be spread in as fresh a state as possible, as they have been found to lose a considerable portion of their strength when long exposed to the atmosphere. It has been laid in various proportions, from 60 to 240 bushels per acre, between the effects of which it is not easy to discriminate, both from the difficulty which we have just stated of correctly ascertaining its strength, and from the variety of soils to which it is applied, which circumstances must necessarily occasion a diversity of practice; but when consisting of that species of waste arising from hard soap, it may be safely employed in the following quantities:—

On strong arable land . . .	from 200 to 240 bushels.
loams, for wheat . . .	160 ,, 200 ,,
do. for barley and turnips .	120 ,, 160 ,,
pasture, generally . . .	160 ,, 200 ,,

It has been generally found most serviceable on wet lands; and if employed on light soils, or in very dry weather, great caution should be used, or its heating quality will have a very prejudicial effect upon the following crop. Upon grass it has even been laid, according to the account of a plain practical farmer, who has used it during upwards of twelve years, to the enormous extent of *forty tons per acre*, without any mixture, and fresh as it came from the vat *. He says—to use his own expression—' that, when mixed up with earth, he found it to be only doing things by halves. It was thought that the quantity would burn up the land, which was only of fair quality; but from the moment of the application the sward took a shade of darker green, and it has since never produced less than two tons an acre of hay, and has carried a heavy stock of New Leicester sheep.' It has been also laid by Mr. Billingsley upon some very coarse meadow, in the

* In the Lancashire Survey it is likewise said, that " about Liverpool they commonly put on from 40 to 50 tons per acre." p. 506.

quantity of six waggon-loads per acre, with very extraordinary effect; the rushes immediately disappeared and gave place to a luxuriant crop of trefoil, which was so obvious that the eye could trace the line of separation during three or four years afterwards. The application of 160 bushels per acre, once in five years, is also said to have more than doubled the product; and in strong, wet, and heavy land, under poor pasture, in the neighbourhood of Epping, four waggon-loads per acre have effected a total change*.

The price is now merely nominal: it was formerly, in most great towns, about 10*s.* for the waggon-load drawn by four horses, for it is never regularly measured by the soap-boilers; but the demand has so far ceased, since the late depreciation of agricultural produce, that the great London manufacturers are now glad to disembarrass themselves of the waste by which they are encumbered by giving it gratis to any person who will take it off their premises.

The best method of using this manure has been thought by many persons to be that of a compost with dung and earth. So far as the earth is concerned, there can be no objection to the practice; but in regard to the dung it may admit of doubt, for, in proportion to the quantity of alkaline matter left in the ashes, the duration of the effect of the dung will be lessened, much in the same manner as by a mixture of quick-lime. If, however, such a compound is determined upon, the dung should be first well fermented, then mixed with at least four times its quantity of maiden earth, and afterwards duly incorporated with the same quantity of ashes as of dung, when the heap should be carefully turned over. By this means the acrimony of the ashes will be effectually corrected, and the compost may be used upon tender loams with better effect than if employed alone.

The following account, among numerous other instances, of an experiment on its effects in equal proportions upon a crop of potatoes, is extracted from a report drawn up by order of the Board of Agriculture:—

No. 1	No manure	produce	134lbs.
2	Stable-dung and soap-ashes	,,	298
3	Stable-dung alone	,,	315
4	Soap-ashes alone	,,	363

To which it must, however, be added, that four waggon-loads per acre have been laid upon twelve acres of a clayey loam, somewhat brushy and soft of heart, which being sown with wheat, no difference could be perceived between that and the crop in another part of the same field†: but it should also be observed, that its power upon the subsequent crops has not been stated.

If applied in large quantities to the land, there can be no doubt that soapers' waste will be found to be a useful and a lasting manure; it destroys slugs and vermin of every description; has been found to increase the product of hay by a ton an acre; and by some farmers the effect of a waggon load of the ashes is considered equal to that of five loads of rotten dung. This we, however, conceive to be exaggerated, if they are applied separately; but, if laid on together, we have witnessed some recent instances which lead us to conclude, that one load of ashes, combined with five of dung, would fully equal ten loads of farm-yard manure in immediate effect, besides producing more permanent improvement.

* Essex Report, vol. ii. p. 246. See also the Report of the N. R. of Yorkshire; and the Papers of the Bath Society, vol. i. p. 129.

† Communications to the Board of Agriculture, vol. vi. art. 39.

If laid on in the shape of compost, the mixture of earth, if taken from land of a different quality from that to which it is to be applied, will doubtless have an additional effect on the improvement of the soil; but if used sparingly, it will, in either case, be hardly felt. In districts where lime is to be procured in abundance, it is not much sought after, as it is looked upon as possessing nearly the same properties; though, according to its analysis, that idea is not altogether well founded, for, although the quantity of alkaline salt and gypsum which it contains is but small, they yet render it superior to common calcareous matter as a top-dressing for every kind of grass. The expense of conveyance is also another objection to its general use; but in the neighbourhood of large manufacturing towns, in which it can be easily procured, and to which farmers have constant occasion to send their teams, it can there be obtained with no further charge than that of back-carriage *.

Chapter XVI.

MINERAL MANURES *continued.*—PARING AND BURNING.

PARING AND BURNING

The ground, both for the purpose of getting rid of the rank vegetation with which land is sometimes covered, and of procuring the ashes as manure, is a practice of such ancient date, as to have been known to the Romans, and has been immemorially used by our ancestors. It is indeed, supposed to have been introduced through the intercourse of the Italians with our southern coasts, and to have been first imparted to the inhabitants of the counties of Devon and Cornwall, whence it acquired the name of *denshiring*. It has since been very extensively practised in various parts of the kingdom, as well as throughout the continent; yet there is, perhaps, no portion of our husbandry, the merits of which have given rise to such wide difference of opinion. It is, however, of the highest importance to farmers that the principles upon which it rests should be clearly understood; for, on soils to which it is applicable, and on farms on which it can be carried into effect, it has been found, when managed with judgment, to be not alone an effectual, but a cheap mode of bringing land that has either lain waste or overgrown with root-weeds and other rubbish into a good state of cultivation: it is, therefore, deserving of their special attention. It must also be observed, that although this mode of preparing earth as manure is very commonly confounded with that of burning clay, yet they differ in this—that, in reducing the soil to ashes, it is supposed that much of its fertilizing properties must be dissipated, and all kinds of earth are thus burned; but, when burnt by the process of slow combustion, it is presumed that the clay—to which the operation is confined—retains a larger portion of its vegetative power, and also has a greater mechanical effect upon the land. We shall, therefore, consider them separately.

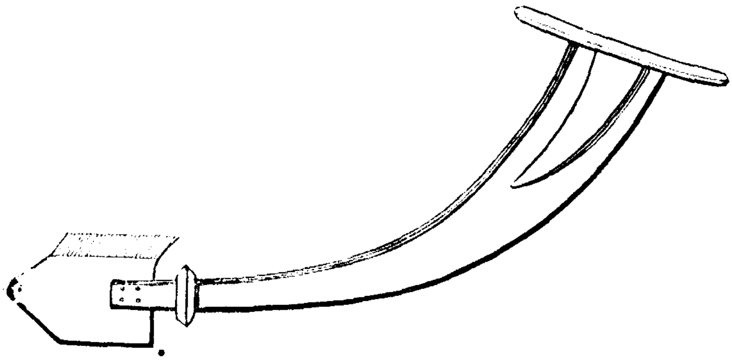
Among the numerous advocates of paring and burning, it is only necessary to mention the names of Arthur Young, of Dr. Rennie, and of Mr.

* See the Essex Survey, Sect. Soapers' Ashes; Adam's Essays on Agriculture, vol. i. p. 167; and a Treatise drawn up by order of the Board of Agriculture upon Soapers' Waste, in the Communications to the Board, vol. vi. art. 39.

Boys, of Betshanger, in Kent, who have written very valuable treatises on the subject * ; to the material portions of which we beg to call particular attention.

PARING IMPLEMENTS.

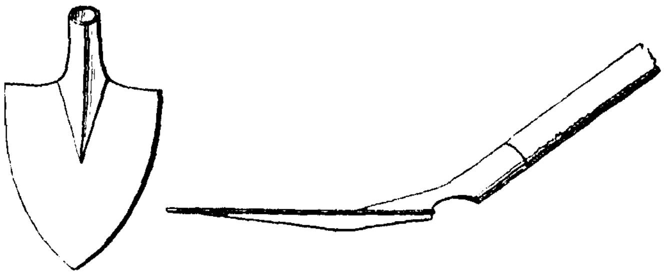
There are various modes of performing this operation, by which the green-sward, or turf, is cut in thin slices from the surface of the land. That which is the most usual is by means of an instrument called a 'den-share,' or 'paring-spade,' and, in some parts of Scotland, 'flawter-spade,' though more generally, a *breast-plough*, from the ancient manner of sometimes using it,—being pushed by the breast of the man who ploughs, though it is now more commonly pressed forward by a board, or by pads of wool, fixed by straps to the front of the thighs ; of which the following sketch will afford a tolerably correct idea.



The blade is about 13 inches long, terminating in a broad angular point ; and at A, on the left-hand side of the tool, there is a small edge, turned up like a coulter, which cuts the furrow in straight lines. The parts which form the blade, or share and coulter, are both of one thin plate, which is required to be of good metal, as the instrument must be kept extremely sharp. The flat, or share part, is somewhat more than a foot broad at its insertion with the handle ; the coulter is turned so that it stands right up when the share is flat upon the ground, and cuts the edge of the turf as the share does the bottom. The shaft is of wood, made with a considerable curve upwards, and it is about seven feet in length ; at the upper end of which is placed a hilt about two feet long, not thicker than a man can conveniently grasp with either hand, and by which he guides it. It is thus pushed forward, cutting the surface of the land as thinly as it is possible to do it, taking care, however, that no herbage is left uncut upon the pared ground, and when in pieces of about a couple of feet in length, it is turned over on the right side by a wrench of the spade given by the workman ; by which means the turf lies hollow, and the ground shows that the whole face of the land has been cut clean. In chalky soils, having a mixture of flints, or when the toughness of the surface occasions much impediment, the share is reduced to 9 or 10 inches, the coulter is sometimes dispensed with ; the blade is then formed of a more oval shape, furnished with a

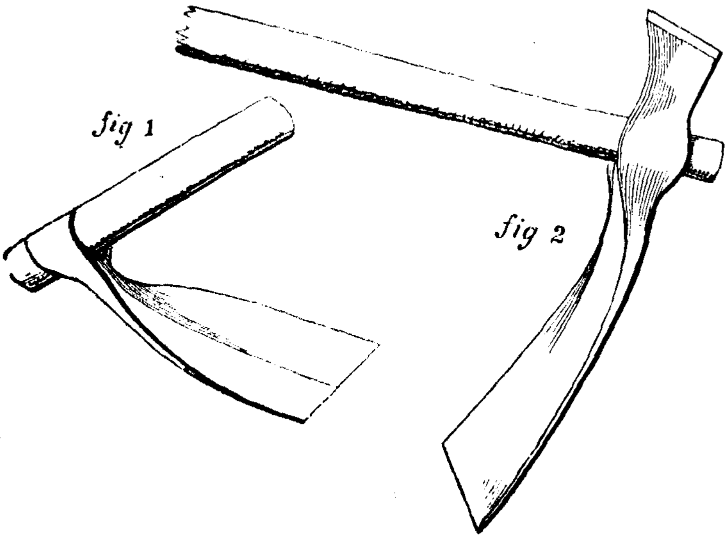
* See the Appendix to the Survey of Kent ; the General Report of Scotland, vol. ii. ch. xii. part ii. and Papers of the Bath and West of England Society, vol. x. ch. vi.

socket for the introduction of the handle, in the following manner, and is a very powerful instrument.



It is excessive hard labour, and when the soil is thickly covered with furze, root-weeds, and other coarse herbage, it requires an athletic man to perform it; but a good hand, upon land that is not too stiff, or cut to a great depth, will pare an acre in four days, and it may be done thinner, and more uniformly, than by a plough drawn by horses, though the latter practice is prevalent in many counties. When a set of men take a job of this kind in hand, they follow each other in the same order as when mowing; proceeding about twenty rods in length, when they return to the end from whence they started, without paring as they go back. The sods, when turned over, should be laid with the best possible exposure to the sun and air, in order that they may dry, which requires two, and sometimes three weeks, according to the state of the weather and the nature of the turf; but, if the latter be light and thoroughly dried, it has been known to be effectually burned in the state in which it lies, without removal from the field.

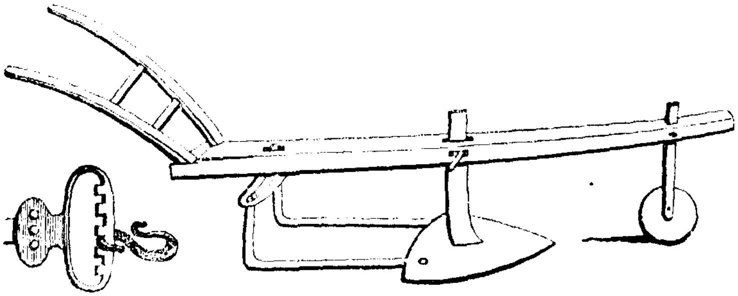
The operation of the breast-plough is generally aided throughout the west of England by a broad axe, provincially called in some parts a 'beating-axe,' a 'kaib-batt,' or *paring-mattock*, and in others a 'cobbing-hoe,'—



which is used for cutting up the stems of furze, which offer too great resistance to the blade of the former, and in particular situations is found indispensably necessary, as the nature of the ground sometimes renders the action of the plough, or paring-spade, impracticable. It is so fashioned upon the shaft as to be inclined inwards little short of an angle of 45° with the line of its handle, as represented in the figure No. 1.

When used for the latter purpose, the sods are always turned in the form of a cone, very small at top and broad at bottom, and, in a tolerably fair season, are therefore sure to dry; but when cut in this manner they are placed with grass upwards, instead of being turned over, as with the breast-plough. The operation is called 'spading the ground,' in contradistinction to that of grubbing the roots of shrubs, which is called 'hand-beating,' and is usually performed with the *two bill*, or *double bitted mattock*, as figured at No. 2 *.

Although the paring of land is thus generally performed by manual labour, yet, such is the toughness of the sward in marshy ground, that horses are often employed; and in the fens of Cambridgeshire and the neighbouring counties, there is a plough much in use, that was formerly brought from Holland. This *Dutch paring-plough*, of which the following is a representation, is worked by a pair, and sometimes even



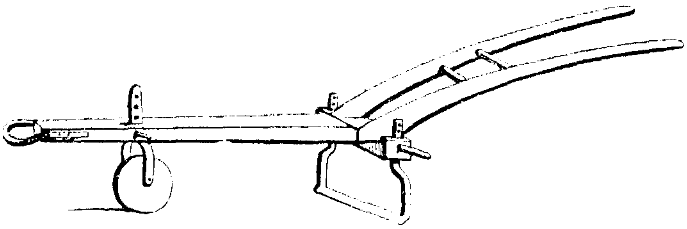
by four horses: it was originally constructed with only one handle, from the hinder part of which projects a kind of crutch, horizontally disposed, and upon this the holder bears with his left hand, walking upright. From the same handle another crutch projects at right angles with the former, but much lower down; and this the holder uses occasionally with his right hand, for the purpose either of assisting to keep the plough steady, or to turn it at the land's end: latterly, however it has been commonly made with stilts, in the common form. Instead of a foot, or wheel, to support the beam of the plough, they use what they call 'a scaife,' which is a circular plate of iron turning constantly round, the edges of which are steeled, and, together with the edge of the share, are kept very sharp by means of a file, which the ploughman carries with him for that purpose, for the share goes so near the surface, that it meets with many strong roots and much coarse grass, which require keen instruments to cut them. The wheel coulter is found better adapted for ploughing among the rough sedge of those marshes than the sword one, and an appendage, called 'a boy,' is likewise sometimes added to lap in the rushes, which it does effectually. There are also some varieties of this plough known as the 'three-quarter' and the 'half-Dutch,' differing in the breadth and strength of the share; which latter are used for that ploughing

* Survey of Devonshire, p. 127.

in which cole-seed, which forms a common crop in the fens, is brushed in, and upon which white crops are harrowed; but are more usually employed among the hills than in the fen country, and, except in their dimensions, they all nearly resemble the original plough, namely, 8 feet in length of the beam; length of the head 21 inches; and 1 foot in height from the ground*.

In some of the moss-lands of Lancashire it has also been found advantageous to keep the horses from treading in the soft spongy bottoms of the furrows, notwithstanding their being shod with pattens: they are therefore harnessed in a line; and the beam of the plough does not, in such case, point in a direct line along the furrow, but is made, by the adjustment of the copse, to incline about four inches to the land †.

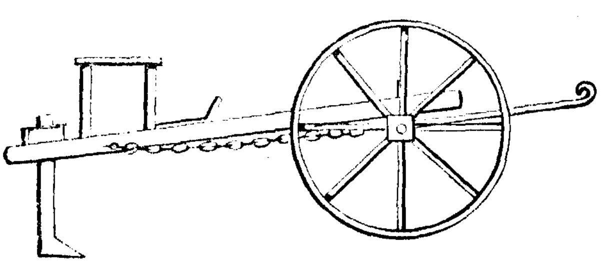
The *Berkshire shim*, which is here represented.—



has the wheel of 14 inches in diameter, and the share of various sizes, but generally 14 inches long at the bottom, by 10 at the top, and the blade 4 inches wide, standing 2 feet from the top of the block to the ground, and from the top of the beam 20 inches. The share is made to rise or sink at pleasure through the block, as the wheel does through the beam; which affords considerable facility in the regulation of the depth to which the turf is to be pared, and it can be drawn by one horse.

In some parts of Berkshire they also have a broad share,—though now seldom used,—the frame-work of which rests upon a pair of large wheels, commonly the old fore-wheels of a waggon, one man driving, and lifting the share at the headlands, while another rides upon the frame, between the stilts. It is drawn by four horses, and being four feet long in the share, though it pares or hoes the ground commonly to the depth of full three inches, it yet goes over a large extent of land ‡.

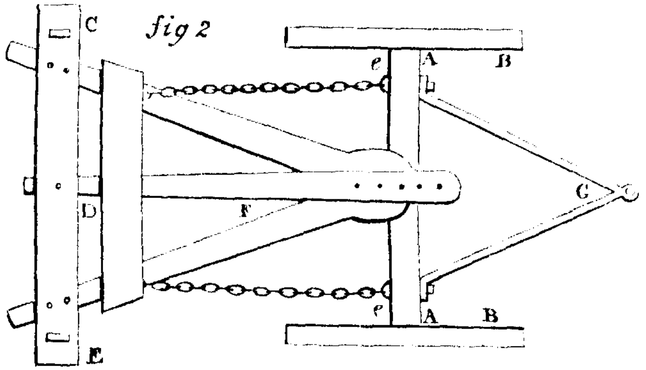
An implement somewhat resembling the foregoing, though on a different scale, and which is thus formed,—



* Surveys of Huntingdon, p. 82; Cambridge, p. 47; and Lincolnshire, p. 75.
† Stevenson's Survey of Lancashire, p. 159.
‡ Young's Farmer's Eastern Tour, vol. iii. p. 108.

is in very general use throughout Essex, and in some parts of Suffolk and Norfolk, and the adjoining districts, where it is employed as a shim, or *hoe-plough*, chiefly for the purpose of cutting up the weeds upon the narrow ridges, into which the generality of the lands, especially when intended for wheat, are there formed; and, as an implement for the destruction of tap-rooted plants, nothing can be more effectual. It is, however, very frequently used for the purpose of paring the turf off waste land intended for improvement by burning; and on arable land, the blade, which cuts a ridge at once, is slightly curved to meet its convexity.

fig 2



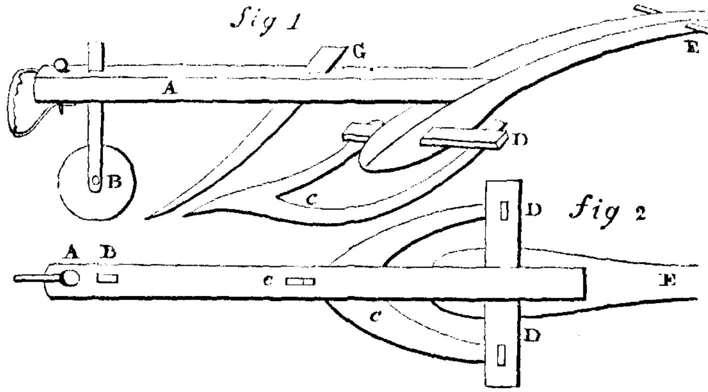
No. 2 is the plan of its construction. A A is the axle, and the wheels, B B, may be about four feet in diameter. The triangular frame, C D E, has a central rib, D F, in the fore-part of which are a series of holes, wherein a stout pintle, fixed to the centre of the axle, shifts, as more or less work is required; the hindermost holes giving the least hold of the soil. In this way the blade, which has its stems passing through mortices, at C and D, is subject to change its level; which has induced some makers to furnish the fore-part of the triangle with a permanent pivot, and to raise or depress the blade according as the occasion may require. To prevent the implement from being swayed to either side, two chains, at *e e*, are carried from the cheeks of the frame to the back of the axle; but not drawn perfectly tight, as, in such case, they would create some difficulty in turning at the head of a land. The driver has a seat upon a board, raised on four light posts, above the blade.

This plough now rarely requires more than two horses, except when the soil is very stiff, when one, and even two more have been found needful: the ordinary allowance of work being from three to five acres. They work in the furrows of the ridge, and are yoked to a swingle-tree, which attaches to two iron bars, furnished with a stout hook, standing nearly upright.

An improvement on this instrument has been recommended by Captain Williamson, of the Bath and West of England Society, the author of some ingenious inventions in agricultural mechanism: which, as we think it deserves to be better known, we shall here take the liberty to describe, under the name of the *paring-plough*.

It may be constructed with a very short beam, A, in front of which a foot-wheel, B, may be set according to the usual method, and the blade, C, may be set into a cross-bar, D, either morticed through, or bolted under

the beam, horizontally at right angles. The cross-piece must be very stout, full 6 inches wide, and 4 deep; its length 28 inches; so as to leave good room for iron collars. One stilt, E, is sufficient. If a bar were placed in the centre of the beam, at G, as marked in the elevation at Fig. 1, and at *e* in the plan at Fig. 2, to serve as a coulter, the turf would be divided in the centre, from end to end; and if the sides or stems supporting the blade were made broad, with a turn inwards, they would, like a mould-board, give the two sides thus made a cant, and occasion their turning over in the centre.



There is also another paring-plough, of a different but more complex construction, designated in the same work, but for the description of which we must refer to its pages *; for we have already gone farther than some persons will think necessary in our account of the various instruments used for this purpose.

The last implement to mention, and, perhaps, in many situations the best for the purpose, is the common plough; for, by using it, the business proceeds with greater despatch, and is attended with less expense for the cutting part, though more for burning: but then there is the great advantage of having much of the soil, which is not burned, pulverized and prepared for the ensuing crops, which is an advantage not attainable in the other method.

The operation of paring with the common plough is however much facilitated by the addition of a share, of two feet in width, stripped of its mould-board. It is fixed by two standard irons to the beam of any plough, before the coulter; in light soils it saves much labour in the cutting of pea, tare, bean, and other stubbles, at about two inches below the surface; and not turning any furrow, it leaves the weeds and roots all cut through, fit for being immediately harrowed out, raked into heaps, and burnt. The shim, or skim, has also been affixed as an additional coulter, in a peculiar form, to a plough much in use in Oxfordshire, where it is found to answer the double purpose of both paring and ploughing. The tool, of which a front view is separately given, is placed as a fore-coulter, and acts upon the sod, which it turns up from either side without effort †.

* See Williamson's Agricultural Mechanism, pp. 254 and 257, and plate 14.
† Survey of Oxfordshire, pp. 78 and 248.

OPERATION OF PARING.

In some parts of England, and throughout Ireland, paring and burning is a kind of trade exercised by expert persons who go about the country for that purpose. In Ireland they generally earn a shilling a day, besides their diet, which is there considered high wages. When the ground is ploughed but once, and the rough sods are piled into large heaps, it is called 'great baiting;' but when the land is cross-ploughed, and the turf shaken into diminutive parcels, it is termed 'small baiting.' In this manner, if the fire be kept close and well covered, as in the making of charcoal, the soil is found rather to receive improvement than injury *; but if let out in 'con-acres,' under the destructive system commonly practised in that country, the land is so exhausted by repeated cropping, that it requires years of rest to bring it about to anything like a productive state †.

In ploughing turf, for it can hardly be called paring, when intended for burning, there are various modes adopted. Some plough it one way, and then cross-plough it, endeavouring thereby to cut it up in square cakes, and others, with a broad stripping share, cut the sod thin, and turn the whole over, with the grass downwards; this is done early in winter, and after lying some time, the land is either cross-ploughed or worked with the tormentors, then harrowed, and such proportion burnt as the farmer may deem expedient: some burn a large portion of the earth, and others little beside the roots and weeds. A second method is, not to strip the leys clear, but to leave a narrow strip of ground whole, on which the furrow slice is turned; which is provincially called in different places, either by the names of 'furrow and comb,' 'turning to rot,' 'ribbing,' 'raftering, or 'baulking.' The third, which is common in Cornwall, when there is not time to permit the sod to rot, and is there called 'velling,' is performed nearly in the same manner as the former, excepting that, instead of being turned over, the furrow-slice is cut with its turf upwards: this is drawn out with small crooks by women and boys, or harrowed, then raked together in heaps, and burned ‡.

Another plan, recommended by Mr. Boys, is, when the weather is set in dry in the spring, to plough the sod as thin as possible (unless it be a very old piece of turf, full of woody roots, which may, in such case, be broken up a tolerable depth) in baulks; that is, to turn the turf the contrary way to the common ploughing, with the turnwrest-plough, laying the land in narrow ridges, about 18 inches in width: when a piece of land is thus gone over, it should be harrowed slightly down, and immediately ploughed in the same manner crossways, at right angles, finishing the whole by splitting, or clearing with the plough, these last made ridges down the middle. By harrowing the land thus prepared afterwards with a coarse harrow once over, the turf will be nearly all brought to the surface, and, after a few dry days, be in a good state for burning, at which time every possible expedition should be used to get it in heaps for firing §.

* Kilkenny Survey, p. 451.

† In this system the 'con-acres' are generally let by middle-men, who hold leases without restriction, to cotters, or poor farmers, at an exorbitant rent, and five or six crops, or as many as the land will give, are taken; two of potatoes successively, where the land has staple sufficient without manure, and three, or sometimes four, crops of corn afterwards; when it is not unfrequently fallowed for wheat, succeeded by a crop of oats. The soil thus employed is usually maiden ground of a rich quality; and in this manner, particularly during the last fifteen years of the late war, half the fee of the land has been realized.—See Lambert's Observations on the Rural Affairs of Ireland, pp. 26, 62; and Curwen's Letters on the State of Ireland, vol. ii. p. 166.

‡ Survey of Cornwall, p. 119. § Survey of Kent, Appendix, p. 259.

consumed. Thus all the sods are burned equally, but as lightly as they can be to be reduced to ashes *.

In some instances circular heaps have been formed over large roots to the extent of 54 feet by 20, and found completely successful. The manner of forming these clamps was thus:—a quantity of large roots was laid upon the ground, and inclosed by a wall of sods three or four feet high, and at the bottom of each side wall were six openings, about twenty inches square, in which faggots were laid, so as to connect with the roots. When the inclosure was filled with sods, and the clamp raised to the height of eight feet, twelve fires were all kindled at the same time, and, in less than forty-eight hours, the whole mass, containing 400 cart-loads, was entirely burnt through to the top; by which mode of burning it has been computed that the ashes cost no more than threepence per cart-load of sixteen bushels †. This method of burning in kilns will however be more particularly described in the following chapter.

The most common method, indeed, is to form the heaps about a yard in diameter, like small hay-cocks, a few yards apart, the sods set edgeways, with a bough of furze at the bottom, covered with some of the driest turf, keeping the sods on the inside as hollow as may be, but laying them flat and close on the outside to keep in the heat. The heaps made in this manner are kindled usually with a link made of tow dipped in tar, and wound round a small stake, the lighter running along the rows from heap to heap, and lighting them. Some skill is requisite in their formation, for, if the heaps be made too large at first, their own weight crushes them down, and destroys the necessary openness of the inner side, while, if too small, the fire, not being sufficiently confined, flies outward, and spends itself prematurely; yet, if the sods in the small heaps are damp, the force of the fires is so soon extinguished, that heaps of four and five cart-loads have been found insufficient; and to this want of precaution in the preparation of the ashes has been partly attributed the defects which some persons have assigned to the practice itself. Yet the weather is sometimes so unfavourable that means must necessarily be taken for increasing the heat of the fires, for which purpose a very simple apparatus has been contrived in Scotland. It is put together with merely a few small old iron hoops, the halves of which are placed so close together as to prevent the sods from

* Strickland's Survey of the East Riding of Yorkshire, p. 203.

† General Beatson's New System of Cultivation, 2nd edit., p. 160. In the supplement to the same work, plate 1, fig. 3, there is an end view of a *stubble-rake*, which, by two operations, crossing each other, tears off the stubble, and lays it in swaths; from which it is afterwards collected and carried to the places where the fires are to be established for burning the roots of the stubble with a considerable portion of the surface soil. The mode of operation is as follows:—

Fifteen or twenty kiln faggots are laid upon the land in a circular space, about 16 or 18 feet in diameter. Stubble is then laid upon the faggots, until this mass of fuel is raised to the height of about three feet. The roots of the stubble are afterwards taken out by two scarifyings, and collected by the rake with a portion of the soil. This mixture of roots and soil is laid over the straw to the depth of about two feet, or more. A loose soil wall is then raised around the circumference of the fuel to the height of 2½ feet, and in this wall there are eight or ten openings, or flues. When the heap is thus prepared, containing at first about 15 or 20 loads, the fires are kindled at each of the flues at the same time; and, when the flames have reached the edges of the interior fuel, all the flues are immediately closed. Wheelbarrows are then employed to bring stubble roots and soil, which are continually thrown upon the heap to keep down the fire, and particularly where it has a tendency to break out. By which means from 30 to 35 cart-loads, or about 500 bushels, of ashes have been procured per acre.

falling through, and riveted to iron rods which lie lengthwise upon the ground, in the following fashion :—

thus forming a sort of portable furnace, about four feet long, so light that a boy can carry it; and when turf is laid upon it, an opening is left through the hoops, which increases the current of the air *.

When the land is much covered with heath and furze, the operation of paring, which turns the sod upside down, keeps the turf raised so far above the ground that, in fine weather, it readily dries sufficiently, and is frequently burnt in that state. This is a saving of trouble and expense; the ashes are also thereby spread more equably, and the fire operates over the entire surface of the soil, which, if anything is to be attributed to the effect of heat, may be benefited by this mode of application †. Thus, in a course of experiments made upon a farm in the West Riding of Yorkshire, the sward was burnt all over the surface in the state in which it was left when pared; when, without any further culture, or seed, a spontaneous plant of luxuriant grass sprang up, and afterwards continued permanent, upon black peat-earth, which formerly produced nothing but heath and ling. Similar experiments have been since tried with equal success, by only adding the seeds of white clover, trefoil, rye-grass, rib-grass, nonsuch, or any of the other grasses commonly intended to produce pasture, and merely harrowing them in without any ploughing ‡.

The improvement of the bogs by the *operation of paring and burning in Ireland*, is thus described by Mr. Curwen : ' Round a space from six to ten feet in diameter, a trench of a foot deep, and of the same width, is dug, the soil from which is laid on the adjoining surface of equal breadth. Beyond this another circle of sods is taken out, and laid to dry in the same manner; and thus the work proceeds, until the quantity dug, with that which is left undisturbed for a floor, is as much as can be properly burnt on the space in the centre. As soon as the sods are sufficiently dry some are gathered together, the heap is set on fire, and additions are made of wet and dry sods from time to time, so as to keep a regular, moderate, and smothered fire, in proportion to the attention paid to which particulars the husbandman is rewarded by the quantity of potatoes he will procure §."

EFFECTS OF PARING AND BURNING

The *quantity of ashes* thus made necessarily depends upon the nature of the vegetable matter which lies upon the surface of the soil, as well as that of the earth, and the depth from which it is extracted. When the object is merely to burn whatever is growing upon the land, without min-

* General Report of Scotland, vol. ii. p. 405.

† ' The effect of heat in this operation is remarkable. Wherever burning has been much practised, experience has demonstrated the necessity of removing all the ashes where the fires were made; and though careful farmers remove some of the uncalcined earth, still these spots manifest a deeper green in the crop than is observable in any other part of the field.'—Young's Essay on Manures; Papers of the Bath Society, vol. x. p. 131.

‡ Annals of Agriculture, vol. xxxiv. p. 122; Middlesex Report, 2nd edit., p. 371.

§ Observations on the State of Ireland, vol. i. p. 146.

gling it with the earth, the ground is then well harrowed after it has been pared, and the loose stuff being raked up and burned, generally produces only from 30 to 50 bushels, which can hardly be considered in any other light than as a cleansing to the soil; except that, when much mixed with brushwood, their roots render the ashes of stronger quality. But it is seldom confined within such bounds; and, when performed in a workman-like manner, upon rough ground of medium quality, to the depth of about two inches, the operation has been known to produce from forty to fifty cart-loads of 40 bushels each, or from 2000 to 2400 bushels per acre *.

The *expense of paring and burning* has been variously calculated, and depends upon so many different circumstances, that it is impossible to form a precise estimate for any other than a particular case; for not only must the soil on which the operation is to be performed be considered, but also the kind of instruments and the skill of the workmen employed, the season, and the rate of wages, which generally bear a proportion to that of horse-labour. In Kent, it has been stated by Mr. Boys as being invariably done with the breast-plough, by the job: that, when the hire of day-labourers was from 2*s.* to 2*s.* 6*d.*, the whole charge on the chalk soils—when confined to a moderate depth, including the laying up of the turf in heaps, and cleansing the hills, when burnt, of the loose bits which escaped from the outsides of the fire, and refiring them on the crown of the hills, so as to burn the whole completely—amounted to from 30*s.* to 50*s.* per acre, in proportion to the quantity of turf burnt; and that, in some instances, he has at that expense made extraordinarily large quantities of ashes. In Suffolk, it is stated, in a late account—if pared by hand and burnt in small heaps—to cost from 30*s.* to 40*s.* per acre; if pared by the plough, half that sum; or, if pared by the plough, and carted to a large heap to burn, 4*d.* per load †. In other counties, where the paring and burning have been paid for by measure, the cost is generally about 9*d.* per cart-load, or, in cases where the work is difficult, 1*s.*

In some parts of Scotland, the expense per acre, on different soils, has been—

On clays	35*s.* ‡	Wages averaging about 2*s.* per day
drained bog	40*s.* §	
moss	45*s.* ‖	
common pasture	53*s.* ¶	

The latter, however, including the charges of ploughing and harrowing, and thus divided—

	£	s.	d.
Paring and burning	1	17	0
Spreading the ashes	0	3	0
Ploughing for the seed	0	10	0
Harrowing	0	3	0
	£2	13	0

These accounts are taken promiscuously from the Surveys, but it is stated in the General Report that the entire expense in no case exceeds 3*l.* per acre.

We also extract from that work the following statement—which is vouched to be correct—of the expense and profit, *per Scotch acre*, attending the reclamation of a large extent of waste land in Gallowayshire; which,

* Survey of Middlesex, 2nd edit., p. 369; Malcolm's Surrey, &c., vol. ii. p. 207.
† Practical Hints on Burning Clay, by Chas. Poppy, p. 14.
‡ Survey of Inverness, p. 231.
‖ Survey of Galloway, p. 226.
§ Survey of Dumfries, p. 323.
¶ Survey of Caithness, p. 174.

we insert, not from any approbation of the course of cropping pursued after it was brought into cultivation, but merely to show the improvement of which ground may be rendered capable: viz.—

		£. s. d.
To original value of the land, from 1s. to 6s. per acre—on an average, say 3s. 6d. Fee simple, at 25 years' purchase		4 7 6
Paring and burning, 35s.; average of draining, 10s.		2 5 0
Lime, 150 bushels, carriage, and spreading		4 15 10
Ploughing and harrowing, for 1st crop		0 15 0
6 bushels of potato-oats, for seed, at 3s. 6d.		1 1 0
Reaping, 10s. 6d.; carrying and stacking, 4s. 6d.		0 15 0
Threshing and delivery		0 7 6
		14 6 10
By 36 bushels of oats, at 3s. 6d.	6 6 0	
Straw	1 1 0	
		7 7 0
		6 19 10
To ploughing and harrowing for 2nd crop		0 15 0
6 bushels of potato-oats for seed, at 3s. 6d.		1 1 0
Reaping, carrying, &c.		0 15 0
Threshing and delivery		0 7 6
		9 18 4
By 40 bushels of oats, at 3s. 6d.	7 0 0	
Straw	1 5 0	
		8 5 0
		1 13 4
To 20 cart-loads of dung, at 2s.		2 0 0
Ploughing and harrowing for 3rd crop		0 14 0
5 bushels of potato-oats for seed, at 3s. 6d.		0 17 0
Clover and hay seeds		1 8 0
Reaping, carrying, &c.		0 15 0
Threshing and delivery		0 7 6
		7 15 4
By 40 bushels of oats, at 3s. 6d.	7 0 0	
Straw	1 5 0	
Hay-crop	5 0 0	
		13 5 0
Balance		£5 9 8

To which, if the improved state of the land be added, which—although three white crops had been thus successively taken from it, was yet estimated to be worth at least 20s. an acre rent—it would, at twenty-five years' purchase, bring the total profit to 30*l.* 9*s.* 8*d.*, equal to 24*l.* 7*s.* **9*d.*** per imperial acre*. In this account it will however be observed, that the fee-simple value of the land is placed to the expenses of the cultivation, whereas it should only have been charged with four years' rent, at **3*s.* 6*d.*** per acre. This yields a profit to the farmer of 9*l.* 3*s.* 2*d.* And supposing—as stated in the Report—that the value of the land was increased at the expiration of the four years, by the improvement that had taken place, to 20*s.* per acre rent; the profit that would have accrued to the landowner, estimating the fee simple in both cases at twenty-five years' purchase, would be only 20*l.* 12*s.* 6*d.* per acre. The system of farming is, however, too injudicious to warrant even that conclusion, though the respectability of the

* General Report of Scotland, vol. ii. p. 412. A deduction of one-fifth of the product and expense will nearly bring the *Scotch* to the standard of the *Imperial* acre.

authority precludes all doubt of considerable improvement having been really effected.

Except on fen lands, the practice of paring and burning is mostly confined to poor districts, consisting of chalky downs, and wastes covered with heath and fern, or any rough land whatever, which is intended to be brought immediately into cultivation; the advantages attending which are thus described by Mr. Boys in the treatise to which we have already alluded.

When *old downs, heaths, or sheep-walks of a calcareous basis of soil*, are pared and burned early in the summer, and the land twice ploughed, however poor the soil may be, it becomes a fine tilth for turnips; the production of a full crop of which upon such lands, where they have never before been seen, and where they could hardly by any other means be obtained, is of such great benefit both to the farmer and to the soil, that it would be needless to say any more in recommendation of the process, were it not necessary for the information of those who are not accurately acquainted with the advantage to be derived from turnips in poor countries.

We have the authority of Mr. George Sinclair, for saying that "all the advantages here spoken of he has ever witnessed to follow the processes of paring and burning, however poor and rough; but the like texture (thin and poor) of soil containing very little, if any, calcareous matter, that is, wild lime, or chalk, had not the like benefit—on the contrary, appeared injured by the effects of the burning."

'A crop of turnips on a pared and burnt soil will support, in proportion to the goodness of the crop and the quantity of fodder used with them, from five to twelve sheep per acre, during five of the worst winter months*. On all dry lands these sheep may lie upon them the whole time, except in very rainy days, by which the land, which is generally very light, is trodden down firm, and enriched with the dung and urine of the animals in such a manner, as to become an excellent tilth for either barley or oats; and, if sown early and kept clean from weeds, will in all probability produce a crop of considerable value: nor is this all; for the land, if sown with clover and trefoil, under either of these crops, will produce the following year abundance of good food for sheep to fold in the summer; by which means it will, with very trifling assistance, become in fine order in the next autumn for wheat, and will produce, in all probability, double the fee-simple before it was pared and burnt. The following summer, and fourth after burning, the ground, if properly tilled, will be in good condition for another crop of turnips; and, as two crops of corn have thus been taken, it is only just that a quantity of dung, equal to what the two years' share of each acre has made, be carried out on this land, after being mixed and trenched over with hedge or ditch mould, scrapings of highways, waste turf from banks, clay, loam, or any other earth that can be conveniently procured: thus another crop of turnips may be obtained, and a foundation is laid for a fresh succession of crops of corn and seeds as before.'

There can be no doubt that this system of cropping is advantageous—of which, indeed, Mr. Boys furnishes ample proof†; but objections have

* As Mr. Boys's farm, of Betshanger, to which his practice alludes, is situated in that range of chalk bordering upon the rich lands in the neighbourhood of Sandwich, in the county of Kent, the sheep here mentioned are probably to be considered as of the South-down stock.

† The following are extracts from twelve different examples of the effects of this practice.

'An old down, or sheep-walk, consisting of a surface of loose chalky mould, with a subsoil of pure chalk-rock, that had been in grass a great number of years, and was much overrun with hassock—a kind of coarse grass common to poor land, and which

been raised to the practice of paring and burning those thin soils, from the supposed reduction which it occasions of vegetable matter; for it has been presumed that the soil itself thereby suffers diminution, and that the tem-

no animal will eat, unless pressed by sheer hunger—was pared and burned early in the summer, and several times ploughed, destroying each time a thick crop of charlock. Early in the next March it was sown with barley, and the crop amounted to six quarters per acre. The land was ploughed again early in the winter, and in the following spring was again sown with barley and rye-grass; the crop nearly equal to the first; and the rye-grass produced a great quantity of sheep-keep during two years, after which it gradually declined, until after a lapse of ten years from the land being first broken up, when it was again pared and burned, and sown early in the month of July with turnips, which grew to an extraordinary size, and were fed off by sheep lying night and day in a fold. The land was then sown with barley and sainfoin, which produced uncommonly fine crops of both corn and hay; and the sainfoin, having been mown during two succeeding summers, was fed off in the following six or seven years, till it became covered with a strong, poor grass, when it was ploughed up five inches deep, and the turf laid up in heaps, about two rods apart each way, and burned for the third time, each heap producing, on an average, fifteen two-horse cart-loads of ashes, or 600 cart-loads per acre. The ground being ploughed up from the subsoil, or loose chalk-rock, which was mixed with the remaining mould and ashes, formed almost a new surface-soil, which was fallowed during the remainder of the summer, and then laid down with oats and sainfoin, which were very productive; and after the further lapse of a few years, it was sufficiently covered with turf to be thought fit to burn again.

'The result of this experiment, which was made by Mr. Boys's father, was the foundation of his own practice, which was continued, with equal success, during thirty-seven years, upon land to the extent of 267 acres.

'Under this management, part of the same kind of down as that already mentioned was twice pared and burned, the crops of barley on the first occasion yielding seven, and on the second five quarters per acre, of the finest quality; after which it was sown upon a clover ley with wheat, which produced three quarters, though no man living had ever known wheat, or even barley, on that land before. A compost of loam, turf-ashes, and dung was then laid upon the ground in the following spring, at the rate of 40 cart-loads, of about 24 bushels each, per acre; and after being a few years under a pasture laid down with rye-grass, trefoil, and clover, it was again pared and burnt a third time: part with the common downshare plough, about an inch in thickness, and the remainder with the turn-wrist, to the depth of five inches; and it is worthy of remark, that not only the crop of tares, and those of wheat and oats which followed, but all the succeeding crops, have since shown, by their superiority, where the soil was pared and burned of the greatest thickness.

'A similar effect was the result upon another field, part of which, being well burnt, produced about 60 cart-loads of ashes to the acre; but the season proving afterwards unfavourable, only about 20 loads per acre were got from the remainder. The whole was sown with turnips, but that part of the field which was the most burnt produced by far the best crop: the oats which succeeded were, to all appearance, more than double in the same spot, and the grass-seeds much the most luxuriant; which is one proof, at least, that rotting the turf for manure is not so advantageous as burning it.

'A field of 20 acres, the soil a very poor, dry, loose, chalky mould, very shallow, and worse than those before mentioned, or, indeed, any land of the kind in the neighbourhood, was pared and burnt, sown with barley which produced 66 quarters, and the *profit* on the crop was sufficient to purchase the land. After being some years laid down with sainfoin, it was again pared and burnt; and a crop of wheat was taken, which was estimated, by several persons conversant in the value of land, to be worth more than the land would fetch if separately put up to public sale. Another field of 38 acres, adjoining the last, was also pared and burnt, sown with turnips, succeeded by barley, clover, and wheat. Then a collection of manure, consisting of loam, dung, and turf-ashes, in equal quantities, was spread upon the land, which was previously got into fine tilth by repeated ploughings; turnip-seed was sown upon it, and the seed and manure turned in together, with very shallow furrows, about twelve inches in width. By this means fine crops of turnips, in proportion to the soil, were raised; and, in consequence of their being fed off by sheep lying upon the land night and day, a great crop of barley was obtained. It was sown with sainfoin, which produced two or three good crops of hay, about a ton per acre; and has since become a sheep-walk, most of it being a good turf, and far superior to what it was formerly.

In fact, Mr. Boys says, that 'of the three principal soils, calcareous, siliceous, and argillaceous, he has always found the last least, and the first most improved by burn-

porary advantage thus obtained by the occupiers of the land becomes a mortgage without redemption upon the fee-simple*. There can be no doubt, indeed, that it tends to lessen the depth of the soil; for though the advocates for it insist that earth cannot be reduced, yet we find that the weight of the substance which is burned exceeds that of the ashes which it produces; and when we consider that the rind of the land, which by this system is pared off about two inches in thickness, is nothing but the relics of plants, which afford the best aliment to renewed vegetation, it certainly does, in this sense, admit of diminution. Besides weakening those soils which are poor and shallow, it also unquestionably destroys the seeds of the best grasses which nature has deposited in the surface of the earth; which is very obvious, from this land being less favourable to grass for a series of years after it has been burned. On down lands, containing tolerable sheep pasture, there cannot, therefore, be a doubt that this attempt at improvement has been prejudicial; for without a due proportion of old sward, a flock cannot be kept all the year in good health; and artificial grasses, however valuable in their kinds, will not alone answer the purpose on soils which require the aid of the fold. This every farmer of experience knows, and the loss of this old turf has been grievously felt in Hampshire, Wiltshire, Norfolk, and several other counties, where the breaking up of heath-land has so far contracted the sheep-walks as to occasion irreparable injury through the diminution of those flocks which formed the surest support of the old tillage †.

Such is the opinion of Mr. Kent, backed by that of many other eminent surveyors of the counties of the United Kingdom; among whom Mr. Vancouver says—'That in the King's, the Queen's, and other counties in Ireland, where paring and burning the thinly-stapled high lands has been unfortunately practised, extensive and naturally-fruitful tracts have been reduced to the lowest and most exhausted state of barrenness and poverty ‡.' It has, however, been much abused in Ireland; as it is frequently performed on land let out at an enormous rent, in what is called 'con-acres,' for the purpose of taking a few exhausting crops, without manure, by which the ground is so much exhausted as to require years of rest to bring it about to anything like a productive state §. In Scotland the practice

ing; but he never knew a single instance of the burning of any sort of soil, without having the effect of increasing its fertility in a greater or less degree.'—See Essay in the Appendix to the Survey of Kent, Examples i., ii., vi., and vii.; and the Annals of Agriculture, vol. v. p. 112; also the Hertford Report, and the Survey of Middlesex, Sect. v., on Sheep-downs; and the Lincoln Report, p. 294.

* 'It never fails, even when carefully done, to lower the surface.'—Cambridgeshire Rep., p. 257. This, however, has been attributed to its destroying the sponginess of some light soils, and rendering them more firm; and if no material portion of nutritive matter be destroyed, the objection may be considered as more specious than real: for if the textures of the earthy ingredients be permanently improved, there is more than a compensation; and if an excess of inert vegetable matter is present, the destruction of a part of it must be beneficial.'—Elem. of Agric. Chem., p. 301.

The Rev. Arthur Young also says, in his Essay on the Conversion of Grass-land into Tillage,—'That in the fens of Cambridgeshire this husbandry has been repeated once in eight years for a century and a half; and the proofs of a loss of depth, in many instances which he has met with, are extremely vague, and hardly to be distinguished from that undoubted subsidence which takes place in drained bogs of every description. In all other soils, the assertion may be safely and positively denied.'—Communications to the Board of Agric., vol. iii. Art. No. viii. p. 123.

† Kent's Survey of Norfolk, p. 187.

‡ Survey of Cambridgeshire, p. 392. See also the Report of the Surveyors of Wilts, Hants, Monmouth, Lincoln, Nottingham, Lancashire, and the North Riding of Yorkshire; section Paring and Burning.

§ Lambert's Observations on the Rural Affairs of Ireland. When the penalty of paring

has been very much given up, probably in consequence of the wetness of the seasons being unfavourable to the operation, and it is chiefly applied to the reclamation of peaty soils, mixed with alluvial matters or with common earth *.

The *indiscriminate paring and burning* of sound dry land, already clothed with sweet herbage, which has grown up and been improved by the pasturage of sheep, does, indeed, appear to have been permanently injurious to such light soils wherever it has been attempted without being followed up by superior management; but upon all fen, bog, morass, or moory lands, and upon those heathy commons and other wild wastes, covered with gorse, or under old sward of a green or rushy nature, the conversion of grass to tillage should be invariably commenced by paring and burning, by which means the land can be immediately brought into cultivation, and the dormant vegetable matter, which in that state can only be regarded as a nuisance, may be expeditiously converted into a large dressing, which cannot fail to produce a very powerful effect upon the soil for many years to come. When the land is in this wild and uncultivated state, its vegetative powers are, in a great degree, inactive; and were the land broken up, without having previously undergone this process, the rubbish thus left upon it would not only impede the operation of the plough, but would become a harbour for grubs, slugs, and other vermin; whereas, when the turf is burnt, these enemies to vegetation are destroyed. If the soil be heavy, the ashes tend to lessen its tenacity, and a fertilizing power is created, which, without the aid of this process, could not have been obtained. Previous and effectual drainage is, however, in all these cases, indispensable; but that work accomplished, and the coarse, unprofitable, and otherwise indestructible covering once destroyed, it must be a miserable system of management indeed that will permit such lands to return to their primitive state †.

The toughness of the sward in the fens is, indeed, such, that it will not fall to decay within several years, unless burned; and it has been founa that cole-seed, in fen-lands, will not grow with sufficient luxuriance to fatten sheep, unless the ground producing it is burnt to parepre it for the seed ‡.

It has, however, been urged, in opposition to this, that the conversion of the sward into ashes, though highly stimulating to the dormant substance lying in the soil, yet would be more nutritive if decomposed by the process of putrefaction; and that the land, if deprived of that nutriment, will become exhausted, unless the deficiency be made up by a proportionate supply of farm-yard dung, or equally efficient putrescent manure. In this remark we fully agree: but yet, it must be observed, that the process is tedious, the tillage expensive, and the result uncertain; while the process of burning, if properly executed, with due attention to the subsequent rotation of crops, and the application of nutritive manure, will be far from

and burning was £5 per acre, many farmers paid it for the privilege during the late war. On several large Irish estates it is, however, permitted to burn tough, coarse ground, upon the tenant's certifying that it was never tilled before; but in some instances this is coupled with an engagement binding him to lay 100 barrels of lime per acre the second year; to take but two crops, and to lay the land down with grass-seeds.—Survey of Kilkenny, p. 451.

* Survey of Ross and Cromarty, p. 208. Though the operation is more expeditious and economical, in soils of this description, than any other mode of improvement, yet, on those composed of unctuous, fat, and bituminous matter, it would be improper.—Dr. Rennie on Paring and Burning: Gen. Rep. of Scotland, vol. ii. p. 408.

† Gooch's Survey of Cambridgeshire, p. 256.

‡ Communications to the Board of Agric., vol. iv. p. 61.

producing the effect of exhaustion. It has, indeed, been well put by that able and extensive farmer, the late Morris Birkbeck, of Wanborough in Surrey—afterwards so well known by his emigration to the United States—that in the course of his experience he has had proofs, equally decisive, on clay and loam, of the preference of paring and burning to fallowing and to sowing on the fresh turf, and never had occasion to observe the impoverishment of the former: on which he also thus further argues.

'If plants are suffered to decay on the spot where they grew, they replace with interest the soil which supported them: witness the vegetative mould which covers the earth in all situations undisturbed by the plough. Thus when a crop is expended on the field which produced it, the field is enriched; and the larger the crop, the greater is the acquisition. Taking the quantity of vegetable matter as the criterion of fertility, land which has been pared and burnt will probably, at the end of three years, if properly managed, possess it in a higher degree than fallowed land; with the additional advantage, that during the three years a much larger proportion of vegetable matter will have undergone the change which vegetation is intended to effect.'

There is much sound reasoning in this; but, although we still hold to the opinion already expressed on the inexpediency of bringing sound old sheep-walk under the plough, yet when the breaking up of land in waste, or under coarse pasture, is from any motive determined upon, then paring and burning is an improvement of the first order, and far superior to that of bringing it into cultivation without commencing with that process. As one instance in point, of which numberless others could be adduced, it has been stated by Mr. Middleton, in his Survey of the County of Middlesex, that on the inclosure of the parish of Hanwell, some years ago, the allotments on Hounslow Heath succeeded well under the practice of paring and burning; and ill, where the turf was ploughed without the application of fire. In the former case, the land was immediately fit for turnips, tares, barley, and clover; in the latter, the tough, wiry-bent heath, and dwarf furze *, kept the land too light and spongy for any crop. Even rolling could not keep it down; for its elasticity raised the soil soon after the roller had passed over it, and it is of so imperishable a nature, that it was likely to plague the farmer for many years. The same effect was observable in the neighbourhood of Beach-Hill, in the same county; and in various instances in the north of England, where inclosure has been carried to a great extent, those who ploughed up the commons without paring and burning have not found their crops succeed so well as those of their neighbours.

The *success of paring and burning* may, indeed, be justly said to depend entirely on the nature of the land. Wherever the soil is already too light,—as in the case of most downs,—burning tends to make it lighter, and is then evidently wrong; but on clays and heavy loams, its effects can hardly fail to be beneficial. In the particular instance of burning land intended to be returned again to pasture, it is however indispensable to observe whether the practice has been proved, in that part of the country, to be favourable to the future production of natural grasses; for, on some soils, it is so—on others it is not †.

Old worn-out sainfoin, and foul couchy leys of every description, may

* It is so difficult to eradicate furze without paring and burning the land, that some allotments on the enclosure of Enfield Chace, which were nine years in cultivation, after having been broken up, were filled with young plants of furze the second year, after being laid down with rye, grass, and clover.—Middlesex Report, 2nd edit., p. 373, note.

† Comms. to the Board of Agric., vol. iii., p. 96.

thus be speedily, economically, and thoroughly cleansed at far less trouble and expense than by any other method; and it is the only effectual mode of bringing fen land under immediate cultivation with any prospect of success. On *sainfoin leys* and *chalky downs*, the best course is to commence with turnips, fed off and repeated, so as to put the land in good heart before taking a crop of barley, with seeds to stand two years; for on those very light soils two green crops should always be taken for one of corn, and, after the lapse of a few years, the land should be again laid down with sainfoin; but care should then be taken not to let it become covered with a coarse sward of natural pasture, which may occasion the necessity of repeating the operation.

Cold, clayey land, covered with a coarse sward, may be pared deeper; but the operation will be found useless, if it be not thoroughly drained and laid dry. It is then very commonly sown with oats; for turnips, even if the land be sufficiently light to admit of their growth, are, on such soils, found to be uncertain as a first crop, and the oats are generally very productive*. The more judicious farmers, however, lime the land immediately after the ashes are spread, and intermix both minutely with the soil, by ploughing it three times, and harrowing it sufficiently between each ploughing. But in this case it is necessary to plough with a very shallow furrow, as, if buried deep, the effect is in a great measure lost†. They then sow cole as a first crop, and afterwards farm the land in such rotations as the nature of the ground will permit: but whatever may be the course pursued, the whole of the green crops should be eaten off upon the ground; or if the stock be soiled, the entire of the manure thus made, together with that arising from the straw of the corn crops, should be invariably applied to the land.

Much of the latter part of these observations will apply equally to the *Fens*: the usual course in which, upon land of middling quality, is, after effectual drainage, to pare and burn, then to take a crop of rape or cole sown upon the first earth, fed off with sheep, and followed by oats; then cole and oats again, with seeds. But others, not uncommonly, take two crops of oats in succession, or a crop of oats followed by wheat, with the intermission of only an occasional crop of rape or clover, and continue a nearly similar system until the land is at length laid down to grass in a state of complete exhaustion, or pared and burnt again. In some parts of Lincolnshire, however, where the strong fenny lands have been brought under a regular course of tillage, the rotation is rape followed by oats; then beans, wheat, clover, and wheat alternately; but both there, and in some of the other rich fens in Cambridgeshire, they occasionally let the cole stand for seed, which, though an exhausting crop, yet in some seasons leaves an extraordinary profit: the oats also bear largely, and carry high prices as seed for the uplands ‡.

ANALYSIS OF TURF-ASHES.

The *qualities of turf-ashes* not only differ essentially from those of which we have already treated, but also vary according to the nature of the soil

* See the Survey of Huntingdonshire, p. 255.

† It has been often observed, that when manure of any kind is ploughed in, the crop is frequently much better in the second year than the first; the cause of which, in the ordinary course of tillage, is, that it is very generally ploughed in too deep: it has therefore been recommended, as the best method of spreading the ashes, to plough first between the rows, and afterwards to scatter them as regularly as possible over the surface.—Ann. of Agric., vol. iv., Art. No. 26.

‡ Reports of Lincolnshire, p. 66; Cambridge, p. 148; and Huntingdon, p. 215. Farmer's Mag., pp. 36 and 289.

from which they are extracted. Except when that is for the greater part composed of sand, the constituent parts of the ashes are found to consist largely of lime, in combination with various acids, principally the carbonic (carbonate of lime); often united to a large proportion of oxide of iron, and sometimes also to sulphate of iron, when it has not been decomposed by the strength of the fire. An analysis was however made some years ago, at the request of the Board of Agriculture, by Sir Humphry Davy, of a portion of ashes made from turf burned expressly for the purpose, and taken partly from the outside and partly from the inside of the heap, so as to form an average specimen.

These ashes were in the form of small lumps, from the size of a pea to that of a hazel-nut. They were for the most part of a reddish colour, but some pieces were black, or blackish-brown, and a few were white: they were all soft and easily broken, and had no perceptible taste or smell. When digested with acids in their mixed state, a considerable portion was taken up with effervescence. After being heated red with powdered charcoal in their entire state, they emitted a smell of sulphuretted hydrogen when acted on by a diluted acid; but pure water, when digested upon them, acquired no alkaline property.

On measuring an acre of the land from which the turf was taken in the common mode of paring, it appeared to have produced an average of 2660 bushels of ashes, which, at their mean weight of 65lbs. per bushel, when dry, would give 172,900lbs., or rather more than 77 tons per acre; the analysis of which shows the following proportions:—

In 200 grains.		In the total quantity.
80	Carbonate of lime	69,160lbs.
11	Sulphate of lime, or gypsum	9,509·5
9	Charcoal	7,780·5
3	Saline matter, principally sulphate of potash and muriate of magnesia	2,593·5
15	Oxide of iron	12,967·5
82	Insoluble earthy matter	70,889

Whether turf-ashes possess any qualities which may imbibe or attract from the atmosphere principles of vegetation not contained in the ashes themselves that are conducive to the growth of plants, is a chemical question which we shall not now discuss. The difference found in their effects, when applied as manure, is chiefly remarkable on grass-land; but our knowledge of their peculiar chemical powers is yet too limited to enable us to state anything positive on that subject; it is therefore evident that no precise quantity can be assigned as being desirable to be laid upon land, whatever may be the nature of the soil. Practically, however, those which are of light weight have been generally found superior to those which are heavy; but, in point of colour, some persons prefer those which approach the nearest to white, to those which are grey; though others place the most value on those nearly red, which last tinge is occasioned by the oxide of iron, and very bad effects have arisen from ashes of a reddish brown, apparently thus impregnated*. To this we can add nothing theoretically; for the accounts given to us by chemists, of their influence upon the soil, are few and unsatisfactory; though it is a subject that well merits investigation.

APPLICATION.

It is obvious that in all cases the operation of paring and burning must destroy a certain portion of vegetable substance, and it therefore can only be really useful where an excess of this matter exists in the soil in a dormant

* Thaër, Principes Raisonnés d'Agriculture, 2nde ed., tom. ii. p. 441.

state; for the accumulation of rank herbage and woody fibre, with which some land is overrun, can only be slowly reduced to a state of mould when left to the process of natural decomposition; nor is it easily brought into a fit state for the immediate purposes of cultivation, even by the application of lime. Burning has also the effect of rendering clayey land more friable in its texture, and consequently not alone better for tillage, but also less retentive of water; for it has been ascertained, that when clay has been burnt, its tendency to absorb moisture from the atmosphere has been reduced in the proportion of 7 to 2*. Thus the process, if judiciously conducted, may change a soil which was tenacious, wet, and cold, into one partaking of the opposite qualities, and therefore better adapted to vegetation. The soils to which it is prejudicial are those consisting principally of sand and flint, consequently, containing little vegetable matter; for it destroys that which is already in too small a proportion to secure the productiveness of the land. But paring alone, without burning, may be safely practised on such soils, when they contain root weeds, and coarse herbage of difficult decomposition; provided the surface be then harrowed, so as to separate it from the earth, and mixed with quick-lime, together with the scourings of the neighbouring ponds and ditches, or clay, if it can be conveniently procured, to form a compost.

It is injudicious cropping, rather than the ill effects produced by paring and burning, when properly managed, that has been the chief cause of bringing the practice into disrepute. Whatever objections may be made to exposing the surface of cultivated land, or soils bearing a sward of esculent pasture, which yields to the common processes of decomposition when brought under the plough, to the action of fire, there can be none to consuming it when covered with plants of such rank growth as to resist putrefaction: they should, therefore, be only received as proofs either of want of precaution in taking off too much of the soil along with the herbage, or of improper management in the subsequent operation of burning. It is true that it adds nothing new to the ground; but it brings at once into use all the vegetable food which it contains: thus, if successive crops of corn be taken, it will in a few years become exhausted, and will require a great length of time to recover. The first crops are generally great; and farmers, induced by the profit thus immediately obtained, too often repeat them without the intervention of green crops, or any application of dung to assist the powers of the soil, which being forced to its utmost production by the stimulus given to it by the ashes, is at length in a condition of utter worthlessness,—unfit for the purposes of tillage, only presenting the appearance of a worn-out pasture, and ruinous both to the present objects of the tenant, and to the future interests of the landlord.

The following may be assumed as a summary of the best practice:—

1stly. To drain the land perfectly, and to lay it dry, before commencing the operation.

2ndly. To regulate the depth of the paring by the nature of the turf, and the thickness of the mat of coarse sward.

3rdly. To burn the turf slowly, but completely, so as to reduce the whole to ashes; yet carefully to guard against allowing the fire to take such hold of the ground under the heaps, as to harden it into pits.

4thly. To spread the ashes upon a shallow ploughing, and as fresh as possible—even hot; as they operate more powerfully in a caustic state than afterwards

* Sir H. Davy, Elem. of Agric. Chem., 4to., p. 21.

5thly. To mix lime in a moderate proportion with the ashes, if the land be clayey; as in this species of soil, the deficiency of calcareous matter renders it essential to the purposes of vegetation, and the two manures assist each other.

6thly. To sow the seeds as promptly as may be convenient after the ashes have been spread and ploughed in.

7thly. To commence the cultivation—if the time of the year and other circumstances will permit—with turnips or cole; but if oats or barley be taken as a first crop, to follow it with two successive green crops; and never to sow wheat until the land be brought into a fine tilth, and perfectly clean.

8thly. To apply the whole of the manure produced by the crops to the ground, and to manage it, generally, in the usual course of regularly-cultivated arable land.

If these rules be strictly adhered to, there can be no doubt that paring and burning will be found advantageous on all soils of the kind we have described as adapted for the operation; but, although neither coinciding in the odium which has been cast upon it by some writers, nor in the praises with which it has been loaded by others, and only viewing it as a means of clearing ground which is encumbered with dormant matter, and thus stimulating the inert powers of vegetation, we by no means recommend it to repetition; for, if the land be properly managed, it can never afterwards become so foul as to require the surface to be pared.

Chapter XVII.

MINERAL MANURES *continued.*—BURNT CLAY.

The burning of clay, for manure, is an invention which has been attributed to the Earl of Halifax, and is supposed not to have been adopted in England until about the year 1730; but it was known in this country at a far more distant period, and has been mentioned in some very old tracts on agriculture, in one of which, published more than a century ago, under the title of 'The Practical Farmer, or the Hertfordshire Husbandman,' the method of preparing and applying it to the land is described in a manner which differs but little from the present practice. In 'The Country Gentleman's Companion,' printed in London in the year 1732, there are also two engravings of kilns for burning clay, with several letters from various persons, stating that the plan had succeeded in many places in both England and Scotland; and that, in experiments made in the latter country, it had been found preferable to either lime or dung, but too expensive. In the North of Ireland it has also been carried on time out of mind, and in the vicinity of the bogs, where fuel is accessible, the manure which it affords is cheap and inexhaustible, and the power of cropping is thus extended beyond what could otherwise be practicable*. An essay has been written by Mr. Burroughs, describing its good effects in very warm terms: many other treatises have likewise been published upon the subject; and the gold medal of the Society of Arts was, not many years since, awarded to Dr. Cartwright for his experiments.

The practice, however, fell into considerable disuse, until it was revived, in the year 1815, by some letters in the 'Farmer's Magazine,' and, still

* Curwen's Observations on the State of Ireland, vol. i. p. 57.

more recently, by the account given by General Beatson of the process, and its consequences, on his farm in Sussex, in which he describes the efficacy of calcined clay, when compared with either lime, dung, wood-ashes, or peat and dung, as equal, and in some instances superior, to any of those manures *. This has been followed by two other publications,—one at York, and the other at Ipswich †,—each nearly supporting the same principle by arguments drawn from practical proofs; and it seems to have been, in many cases, sanctioned by the experience of extensive farmers, of which we shall here state some instances.

EXPERIMENTS.

A turnip-field was manured by Mr. Craig, of Cally, in Gallowayshire, partly with rotten stable-dung, and the remainder with the ashes of burnt clay. The seed, which was of the yellow field sort, was sown on the same day, but that on the ashes sprang up the earliest, was the most vigorous during the season, and the crop was far superior to that produced by the dung, or to anything of the kind in the neighbourhood. A following crop of Swedes was calculated to weigh fifty-two tons,—equal to about *forty tons per English acre*,—including tops and tails; but, as they grew in the centre of a preserve, the greater part of the tops were stripped off by the pheasants, and some of the roots were eaten by hares.

A friend of this gentleman, an extensive farmer, though it was late in the season when he sowed his turnips, yet obtained a premium from the Agricultural Society of the Stewartry, and the first prize of the Highland Society, for twenty acres manured with clay-ashes, at the rate of forty-five cart-loads per acre; which he however afterwards reduced to thirty loads, and declared himself so satisfied with the result, that, although his farm was only a mile and a half distance from Kirkcudbright, yet he would not be at the trouble of carting dung from thence, even if he could get it for nothing ‡!

Burnt clay, also, when applied to turnips, on a farm consisting of stiff clay, in Annandale, at the rate of sixty cart-loads per acre, produced a better crop than dung upon the same land; and, when succeeded by barley, no difference was observable in the produce. The cost, in 1818, never exceeded sixpence per single cart-load for the labour and expense of burning, exclusive of that of cartage, and in some seasons did not amount to more than threepence or fourpence §.

Mr. Curwen also states, about the same time, that he had made 2000 single cart-loads of ashes from burnt clay on his farm in Westmoreland, and had raised from them fifty acres of Swedish turnips fully equal to those largely manured with good dung ‖.

Major-General Vavasour, of Melbourne Hall, near Pocklington, in Yorkshire, having a large farm of a strong clay soil thrown upon his hands in a very impoverished state, commenced the practice of burning clay, and manured one-half of a field with ashes at the rate

* See 'A New System of Cultivation, without Lime, Dung, or Summer Fallows, as practised at Knowle Farm, in the County of Sussex;' by Major-General Alexander Beatson. Second Edition, p. 21.

† 'Cheap Manure, produced by the newly-discovered Methods of Burning Clay;' Anon. York. Second Edition, 1822; and 'Practical Hints on Burning Clay,' &c.; by Charles Poppy. Ipswich, 1830.

‡ Farmer's Magazine, vol. xvi. pp. 138, 139.

§ Ibid., vol. xix. p. 279.

‖ Ibid., vol. xvii. p. 429.

of twenty solid yards, or about twenty-five tons per acre; the other half with fifteen tons of dung; and the former was decidedly the best crop. The same result has been experienced in corn crops upon the same farm; and land which had been laid down with seeds, and top-dressed with clay ashes, became uncommonly luxuriant *. On the Wolds, in the East Riding, twenty to thirty cubic yards are also said to have been found equal to from eight to twelve tons of good fold-yard manure, when used for wheat and for every kind of green crop †.

These experiments, it will be observed, were made solely in comparison with unequal quantities of clay ashes and yard dung, but those of Dr. Cartwright were carried on comparatively with the ashes of clay at the rate of 400 bushels per acre, 100 of those of wood, and 50 of soot, laid upon an equal portion of cold, wet, tenacious land, without any top-dressing, and applied to different crops, of which the following was the produce:—

	Swedes.		Kohlrabi.		Potatoes.	Barley.	
Burnt Clay	25 tons	2 cwts.	6 tons	17¼ cwts.	480 bushels.	4 qrs.	4 lbs.
Wood-ashes	23	12	3	18¼	456	4	2
Soot	16	12½	4	17¼	432	4	2
No top-dressing	10	4	4	7½	340	3	0

It thus appears that in each of these the burned clay displayed a superiority: the disparity between the turnips which were top-dressed, and those which had not that advantage, is partly attributed to the protection thus afforded to the young plants from the fly; but it is difficult to account for the extraordinary deficiency in the produce of the kohlrabi, spread with wood-ashes, when compared with the part left without manure. The Doctor says, 'that he had no convenient way of judging the experiments on grass-land but by the eye, yet that, so far as that enabled him to judge, the burned clay was without question superior; and the soot, as in all the other trials, except the last, was evidently more powerful than the wood-ashes.' The quantity, indeed, of clay-ashes was greater; but the expense he only calculates at 15*s*., while that of the wood-ashes and soot cost in each instance 50*s*.: though on this it should be remarked that the charge of spreading, and probably of cartage, must have been greater in the former case than in the two latter ‡.

Mr. Burroughs, after detailing the difference in the chemical qualities of burned earth, in the essay to which we have already alluded, and to which we shall hereafter refer, says that 'lime being established as a valuable application to many soils, it would be no easy matter to persuade those who have not tried the former as a substitute, that it possesses more fertilizing properties; but, then, experience, by which all must be governed, has convinced me that burned earth is by far more valuable, on many soils, than lime. I have tried it on *strong clays*, on *light soils*, and on *moory soils*, on all of which it produced good crops of potatoes and turnips, and afterwards corn; and in one instance in particular, where lime had been ineffectually applied, a dressing of burned clay made the land yield most abundantly. Lime only stimulates and pulverizes the soil, whereas burned earth not only possesses those properties, but contains within itself enriching and vegetative qualities.' In proof of which he gives the following facts:—

* The men contracted to burn the ashes at 8½*d*. per cubical yard, making the walls and carrying the wood and clay to the kilns. This was in 1816, when wages were at about the present rate.

† Farmer's Magazine, vol. xviii. p. 383; and vol. xx. p. 154.

‡ See the Transactions of the Society of Arts, vol. xxxvi.

1. A wheat stubble, on a light sandy loam, gravelled as a preparation for that crop, was sown with barley in the following spring; the land being winter fallowed, and in good tilth: part of the field was dressed with burned clay, and part with lime and clay compost The crop was sown and treated on both parts alike, but that portion of the ground to which the burned earth was applied produced by far the best quality of grain, and also a larger quantity to the acre.

2. On a moory field, prepared for a potato crop, a heavy dressing of strong clay and lime compost was laid on, as the land was not considered sufficiently strong to take pure lime with advantage; part of the field remained undressed till the middle of May, when it was manured with burned earth, which was dug from the headlands, and the crop was better than where the compost had been applied.

He then adds, that 'burned earth may be depended upon as a manure fit to produce abundant turnip crops, of every description, on a variety of soils; even the Swedes, so difficult to grow on light land, will prove a more luxuriant crop with this manure than with farm-yard dung, and are less liable to be cut off by the fly. It may be supposed by some that any crop sown on this manure would be precarious in dry seasons, not containing, as they may conceive, any enriching quality or properties to preserve moisture: but this is by no means the case, for it will be found that an application of burned earth makes the land on which it is applied more capable of absorbing moisture from the atmosphere; and, by minutely dividing the soil, the roots of plants can search more freely for nourishment. I have often observed that farm-yard dung, unless very well prepared, does not, in excessive dry seasons, supply sufficient moisture to the roots of plants; and that, during such seasons, crops sown on ashes, or burned earth, have uniformly thriven, while those in dunged land have gradually declined*.'

General Beatson's farm—which consists of 300 acres, 120 of which are arable—was managed for some years previous to his death under an entirely novel system of culture, respecting the details of which we purpose giving some account in a future portion of this work; for although it has been only slightly followed in a few instances, there is yet much of his practice which merits consideration, and every new plan, which is not decidedly proved to have failed, may be fairly deemed entitled to candid investigation. The plan on which it had been previously conducted was so unprofitable, that he had determined on abandoning the farm altogether, when his attention was attracted to a small inclosure, where he had four burnt clay experiments, around which was a space unmanured, and beyond it all the rest of the field manured with rotten dung at the rate of forty loads per acre, the whole carefully scarified, harrowed, and drilled, exactly in the same manner. Those clay experiments not only maintained a very striking superiority during the growth of three successive crops—the first being a mixture of tares and oats, and the second and third wheat; but were also perfectly clean, whilst the dunged part was absolutely choked with weeds: they had each respectively at the rate of ten, twenty, thirty, and forty cart-loads of the ashes per acre. This gave rise to his subsequent practice, which, according to his account, he continued with complete success for upwards of six years, during which time the entire of his arable land was manured with the ashes of burnt clay, his farm dung being solely applied to his hop-grounds, and a few acres of potatoes †.

* 'Essays on Practical Husbandry,' by Edward Burroughs, Esq., No. 11, p. 75.

† He says that his wheat yielded a return of twelve for one of the seed; or 33 per cent. better than the usual return in his vicinity, which, upon an average, is only

ANALYSIS.

The term '*burned earth*' may be understood as implying any species of soil capable of being dried up by excessive heat. Moory and light sandy soils, being deficient in tenacity, cannot, however, be so applied with advantage; but clay, of all sorts, and strong loams, are well adapted to the purpose. It has, however, been observed by Mr. Burroughs, 'that this mode of preparing earth, as a manure, is upon a principle very different from that of reducing it to ashes; and though the effect produced on the land to which it is applied may be apparently the same, yet the torrified' (dried by fire, or scorched) 'substance is by far more permanent. The chemical difference in their preparation is this:—In reducing the soil to ashes, much of its fertilizing properties are dissipated, and its vegetable matter destroyed; but, when only torrified, those properties are preserved, and its vegetable matter only reduced to a state more valuable as the food of plants.'

'There are two sorts of burned earth,—1st, that which is obtained from the surface, of which we have already treated; and, 2ndly, that which is dug from the subsoil.' 'Subsoil, calculated for this purpose, may be said to be of two kinds, viz., adhesive clay, and calcareous earth: the former seldom possessing any fertilizing properties in its natural state; but the latter is, even in that state, generally a valuable substance. As alteratives to the soil, they may be good applications, if appropriately applied, and may produce fertility accordingly; but by putting them through a process of torrefaction, however naturally deficient in fertilizing properties, they can be converted into valuable manures *.'

Mr. Naismith also says, 'that when cohesive earth has undergone this operation, and is afterwards reduced to powder, all its tendency to coherence is lost, and its particles lie compact, without uniting. It seems to have the perfect consistence of a fertile soil; for corn springs quickly, and tillers abundantly on it; and if a little dung-juice be given from time to time, it will grow luxuriantly to maturity. It has also a strong tendency to promote fertility when applied to other soils; and even a very slight torrefaction of the soil has a great effect †.

EFFECTS OF BURNT CLAY.

From this we should be led to conclude that a very material difference would be found to exist in earth thus merely dried; for there can be no doubt that its properties must depend upon the quantity of vegetative matter which it contains. But it is difficult to draw the line between this process of torrefaction and that which consists in burning the earth to ashes: for if the clay be merely dried, the next rains will reduce it back to its former state, by which the soil cannot be benefited; and if the fire be advanced to a degree much stronger, it will probably have the effect of consuming the earth to ashes, in the qualities of which no perceptible difference will be found. In the latter state, indeed, we are strongly of opinion that its effects are purely mechanical—acting upon heavy soils merely by correcting their tenacity, and rendering them less stubborn; but this will doubtless

20 bushels per acre from 2¼ bushels, if drilled, and 3 if sown broad-cast. New System, &c., 2nd edit., pp. 82 and 108.

* Essay, No. 11, on Manures, p. 62.

† Essay in vol. ii. of the Appendix to the Gen. Rep. of Scotland, p. 95. In his Elements of Agriculture, he also says, 'the powder of burned clay lies always in that happy medium between cohesion and repulsion of the particles, which is best adapted to give admission to the roots of vegetables,'—p. 340.

contribute greatly to their fertility, though it cannot be considered as a nutritive manure.

The stress which has been laid upon the supposed value of some kinds of burned clay, in consequence of the calcareous matter contained in the subsoil, is probably overrated; for it is seldom found, in soils of that description, in such abundance as to be of much service as a manure to other lands. We learn, indeed, from an experiment of General Beatson, that when even the surface-soil has been burned, no difference was found between the effects of that, although containing vegetative matter in the sward, and the ashes of common clay; though the quantity applied was perhaps too small to warrant any positive conclusion*. We, therefore, think that the ideas which have been entertained of the effects of this manure, are rather too sanguine; and we are decidedly of opinion that the expectations of those of its advocates who imagine that 'burnt clay will supersede the dung-cart' will be disappointed. It appears, indeed, from a more recent essay by Mr. Burroughs, on the cultivation of white crops, that he has not been so well satisfied of its good effect as to persist in its use instead of farm-yard manure; for although we there find him recommending the use of the latter, he yet makes no allusion to burned clay. In Scotland, also, where the burning of clay was a few years ago very extensively practised, we learn that it has since fallen into considerable disuse. There can however be no doubt that clay ashes may be beneficially used; but it does not appear from past experience that they can preclude the use of lime on soils not formerly dressed with it.

We make no apology for the length of these extracts, for the subject is of great importance, and although we entertain doubts of the accuracy of the inferences drawn from the experiments by some writers, yet that should not prevent any farmer who possesses the means of satisfying himself by similar trials, from ascertaining their effect by actual practice. It is true, that the nature of some soils does not admit of it; in others, the land is in many cases so valuable, that almost every inch of it is in profitable use; and as it requires about 150 square yards of surface, 6 inches deep, for a single acre, or a pit of proportionate size, if dug from the subsoil, many persons will naturally grudge the sacrifice, though banks and headlands—something, in short, in the shape of waste—may be found on every farm. Every one who has the opportunity should give it a fair trial; and if the result should prove its efficacy, it may then, indeed, be considered 'as opening a new field to the prosperity of agriculture.' The following are the most approved methods of preparation, when pits are dug from the subsoil; but if the earth be taken from the surface, then those directions will be applicable which have been already given in the previous chapter, under the head of 'Paring and Burning.

CLAY-KILNS.

There are two modes of burning clay commonly employed, one by kilns partly constructed of masonry, and the other of sods; in both of which the earth is piled upon them, instead of being placed under cover, as in a lime-kiln.

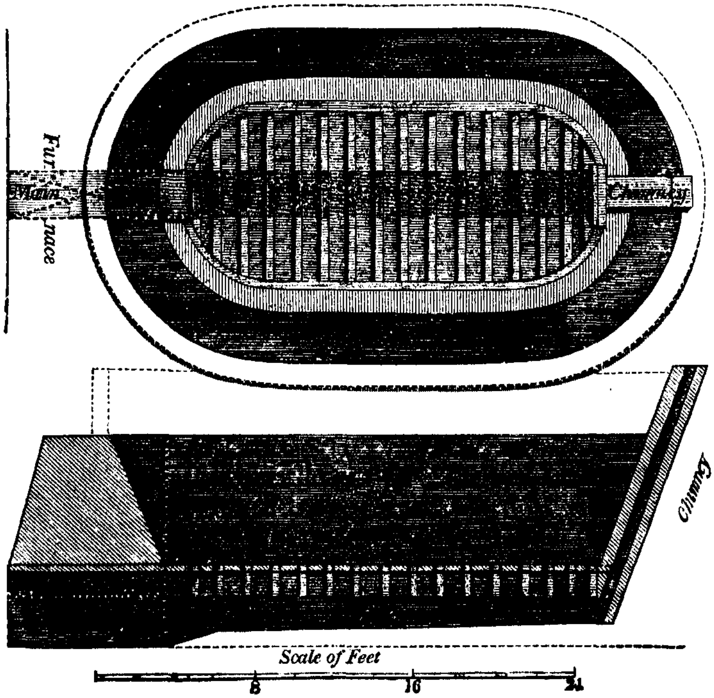
The kiln of the former kind, described by Mr. Burroughs, should be built in a pit excavated out of the ground which is to be burned, and con-

* Part of a field of eight acres was manured with the ashes of stiff soil burnt in a kiln, and another part with ashes obtained by paring and burning, at the rate of 20 cart-loads per acre. The whole field was drilled with wheat, and the crop was excellent; but no difference was perceptible at the time of growth, nor at that of reaping. New System, &c., 2nd edit., p. 159.

sists of an arch about 4 or 5 feet long, 3 wide, and 2 high, made with brick; the front close like an oven, and the inside fitted to receive a strong fire of coals. On the top of the arch six or eight holes are left, the size of a small brick, to admit the heat passing out, which is to communicate to the earth laid on. When the fire is sufficiently strong, the door of the kiln is to be well stopped, and the earth thrown on in some degree pulverized, about six or eight inches thick, so as to cover the top of the kiln, and every direction round it to which the heat might communicate. In this manner it is to be dressed alternately with culm and earth, which are to be laid on according to the heat of the fire, which is on no account to be allowed to burn too strong.

After the kiln is once lighted, it will burn several hundred bushels of earth without any additional fire inside; and the same kiln will answer for a length of time to renew the process when necessary.

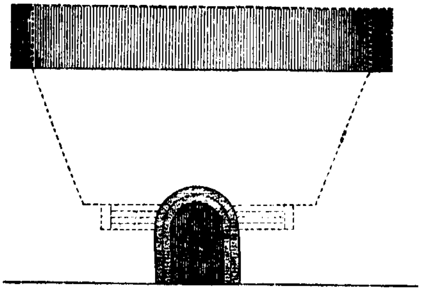
The kiln used by General Beatson, which burns 250 cart-loads of 16 bushels each, was subsequently erected upon a more scientific principle; but as the form and construction cannot be fully comprehended without an engraving, we here insert the plan, elevation, and section.



The iron floor, formed in the manner of a gridiron, by transverse flues which convey the heated air immediately under the clay, has been found necessary in kilns of large dimensions, but in those of a smaller size they may be dispensed with; and an arch, or main flue, passing from the furnace to the back of the kiln, and having a chimney at the farther end, will answer the purpose.

The site of the kiln, which is dug out of the ground, should be as near as possible to the materials that are to be calcined. Steep, sloping banks,

in which the furnace can be placed low, are evidently the best situations, because the lower the furnace the deeper may the excavation of the body of the kiln be sunk, and the more capacious it may be made. When the site is determined upon, the surface ground should be levelled, and the upper dimensions of the kiln accurately traced. The body is then excavated, the sides and ends gradually sloping in the manner represented in the dotted lines in this transverse section of the elevation of the breast of the kiln.



When the excavation has been completed to a depth sufficient for the furnace and flue, the trench for the latter, thus made from the breast to the back of the kiln, has a gradual declination from the back part, or chimney, for the purpose of letting off water: the inside is lined with bricks placed lengthwise. These two walls, four inches and a half thick, form the pier or support of the open arch, which is made with arch bricks, laid also lengthwise; so that each arch is nine inches broad, leaving open intervals of four inches and a half. The open arch should have three ties, or a continuation of bricks, one along the key, or centre, and the other two along the sides, at half the distance between the key and the spring of the arch. These ties render the whole of the open arch firm, and not liable to be deranged by the heavy load of clay which is to be laid upon it.

A kiln of the dimensions here described is stated by General Beatson to require about 3000 bricks for its construction: mud mortar is used; and the expense of building the furnace, flues, &c., is only calculated at about 10*l*. or 12*l*. The size may be either increased or diminished, according to the measurement in the scale.

The clay is at first laid on carefully in large pieces, leaving wide interstices for the admission of heated air all along the arch of the main flue, and iron flues in the sides when the kiln is large enough to require them. When the clay has covered these to the height of two or three feet, it may then be heaped upon the kiln, but the largest pieces should be always put in first, and the smaller reserved for the upper covering, in order to allow a free passage to the heat through the interstices of the latter. The clay should be rather in a moist state, because, if laid on when too dry, it is apt to be hardened by the heat; but if damp, or moist, the whole becomes in a manner steamed, and calcines into a light, porous substance, which easily pulverizes upon being exposed to the air. A cart-load, or sixteen bushels, of moist clay, weighs about 1500 lbs., but, when burnt, the weight is reduced to 1200 lbs. The kind of fuel must depend upon circumstances; but, in the midland counties, generally consists of wood, which may commonly be procured at about 4*s*. the cord for large roots in a rough state, or at the same price per 100 for faggots. Upon an accurate experiment made in a small kiln, 21 feet by 9, having a furnace and an open arch flue, the result was, that with 275 faggots and half a cord of

roots, 80 cart-loads of clay were completely calcined at an expense of 13*s.* for the fuel, or less than 2*d.* per cart-load; and the whole cost, including labour, was only 10½*d.* per cart-load.

A more economical mode than the above has, however, been discovered in the kiln used by Dr. Cartwright, and described as follows * :—

A trench was made,—having a sufficient fall for taking off the water,—about twenty feet long by three feet deep. At the upper end, and resting on its sides, a brick arch was turned, about nine or ten feet long, having openings for letting the fire through the clay, which were made by leaving out half a brick at proper intervals. In the front of the arch is a strong wall, two inches thick, which has its foundation in the bottom of the trench, and is two feet wider on each side than the arch, above which it rises about a foot; a mouth being left through it to the arch about two feet wide. The whole erection does not require more than 500 or 600 bricks: no lime, except for the front wall, is necessary, as the arch can be laid in loam or marl, mixed up to the consistency of stiff paste, and, if properly made, will last for many years. If, however, the saving of this expense be an object, the arch may be made of sods or spits of clay; but perfectly dry, or they will not support the weight. The centre may be formed by laying four or five strong stakes across the trench, and upon these faggots, in a circular form, to build the arch upon: when the work is finished, set fire to the centre of the faggots.

In setting the kiln care should be taken, especially at the commencement, to lay the sods hollow, that the fire may draw through them freely. When the pile is about two feet thick upon the arch, the fire should be lighted, and a sod-wall made round the kiln, which may extend about two feet wider than the arch, and will be supported in front by the brick wall, but must not be more than three or four feet high. As the fire proceeds fresh clay must be added,—still letting it be as hollow as conveniently may be,—and when the heap is between four and five feet high, and burned through, the fire may be suffered to die out. But, if necessary, clay may be still added for a day longer at least.

Dr. Cartwright states that two men and a boy burned 35 good cart-loads, of 20 bushels each, in two days and a half, and the fuel consumed was 175 furze faggots, the expense of which he estimates thus:—

	s.	*d.*
Labour	14	9
Furze Faggots	8	9
A Donkey and Cart (two days)	3	0
Total	£1 6	6

This, which is equal to 9*d.* per cart-load, would only amount to 15*s.* for a top-dressing of 20 cart-loads, and may not be far from the mark; for although good faggots are seldom to be obtained so cheap, and the hire of a donkey and cart is somewhat too low, yet the men's wages are charged at 2*s.* 6*d.* a day each, which is higher than now customary.

Kilns constructed of masonry, although the most permanent, have, however, been objected to, both because of the outlay in their erection, and the inconvenience often experienced in procuring workmen to build them. There is also this further disadvantage,—that, although when once built there is an end of the expense, and with proper care they may be employed for years, yet, if placed at any considerable distance from the land to be manured, the cost of carriage will probably exceed that of burning. They

* See the Repertory of Arts, Manufactures, and Agriculture, No. ccxii. p. 78.

are, therefore, usually formed in the very field on which the clay is to be laid, and out of which it is dug; in which case they may be made entirely with sods, or mud and straw, in the following manner:—

On a headland, or waste piece of ground, off which sods can be procured with sward sufficiently tough to build a wall, erect an oblong or a circular inclosure, about eight or ten feet in diameter*, and two feet thick, but not higher than three or four feet. On a level with the surface of the ground, cut flues, opening through the opposite sides of the wall, so that they may all meet in the centre of the kiln; make them also about five or six inches deep, and four wide, and let them be covered with sods on the top, so as to keep them free of clay and rubbish, and the mouths well open to the air. Then, in the centre of the kiln, place brushwood, turf, or any combustible, with some blocks of wood to strengthen the fire, and, when all is well kindled, throw on some culm—if you have any—and then clay, and so on, adding clay to the heap as the fire may be found sufficiently strong to take the dressing; always observing to keep the heat of the kiln as even and as moderate as possible,—just of sufficient strength to expel the moisture from the layers of clay as they are laid on. Much care should also be taken not to cover the fire too soon after being lighted, as that might extinguish it totally, and therefore the clods first put on should be of the largest description, that spaces may thus be left for the free admission of the heat. The smoke must be prevented from escaping; but the progress of the fire, as it ascends, may be ascertained by occasionally thrusting a finger here and there through the surface; to which, if it has approached very near, more matter must be added.

The walls, when made of sods, should be beat close with the spade, in order to prevent them from drawing air, by which the burning of the clay would be much retarded; the kiln may be then immediately lighted; but if made with mud and straw, they should be permitted to dry before the fire is kindled. They should not, at first, be built higher than three to four feet, nor the inclosure be wider than ten, because the earth can then be flung easily over every part; the fuel will also be thus more easily placed, and the firing more conveniently managed. As it is not necessary that much neatness should be observed in the construction, a kiln of this size may be erected, under proper directions, by five or six men in the course of a day. When the inside of the kiln, however, begins to be filled up with clay, then the wall must be raised as high as may allow the earth to be thrown on without much additional labour; and care should be taken, during the burning, to keep the wall fifteen or eighteen inches higher than the top of the clay, in order to prevent the wind from acting on the surface of the fire. As soon as the fire is strongly kindled, the mouths of all the flues, except the one to windward, should be stopped, and even that will only be of use at the commencement of the process; for, if the fire burns with tolerable keenness, the sods of which the flues are composed will soon be reduced to ashes. Some people, therefore, dispense with the use of flues altogether; but the trouble of making them is very slight, and the want of them often occasions difficulty in the management of the fire.

The kiln may be increased to any size, by raising a new wall round the former when that one has been burned through; and in this manner kilns

* Mr. Burroughs recommends walls eight feet square in the clear, and well joined at the angles by crossing the sods; but the contents of the circular kiln will probably burn more equally, and in other respects there is no material difference. See, also, Cobbett's Year's Residence in the United States of America, part ii. chap. iv

have been made so large as to contain more than 100 loads of ashes: but, as these walls cannot be equally pulverized, they should be broken down, and blended with the contents of the kiln, as that is burning out. No precise period can be fixed for the time which the operation will occupy, as much will necessarily depend upon the quantity of matter, the nature of the fuel, its management, and the state of the weather; most accounts, therefore, affirm, that it can be well accomplished—that is to say, both sufficiently burned, and afterwards cooled, in a few days; some, in a fortnight; others, in a month; but Mr. Burroughs says, that it requires about six weeks, and that it will not then be in good order for the land until after two months longer, for it will take considerable time to reduce it to powder. When the kilns are burnt out, the ashes are still paler than the original clay, and are generally in a powdery state, or are easily rendered so by a slight stroke of the shovel, either when filling the cart, or when they are spreading upon the ground: this, indeed, should never be neglected if there be any appearance of lumps, for if the earth be not completely pulverized, it will have little other effect upon the land than may be expected from bits of brick. The expense of burning clay in the kiln here described is stated to be, in Ireland, from 3*d.* to 4*d.* an Irish load, or about 40*s.* or 50*s.* the Irish acre,—equal to about 32*s.* Imperial measure; but, with the usual inaccuracy observable in all accounts of manure *per load*, we are left to guess at its contents.

The chief art in burning is, *to keep out the air, and keep in the smoke;* which can only be accomplished by having the walls made quite close, and taking care to have the tops always lightly covered with clay. If the smoke should appear coming out in spots here and there, cover those places with sods immediately; for by thus half burning or charring the earth, it is supposed that any vegetable matter which it contains will be preserved, and that the staple of the land will not suffer. In short, the kilns must be carefully attended to, both day and night, until the operation is completed. No rule can be laid down for the size of the clods, but those first laid on will burn more readily if dug up and dried a day or two before: if they be properly managed, that, however, is not absolutely necessary, and if once the kiln is fairly set a-going, no further fuel of any kind is required; for the clay, though wet, will continue to burn, unless extinguished by carelessness, as even the changes of the weather, except in very bad seasons, have very little effect upon it. It may, however, be proper to caution those who are not acquainted with the process, from opening any part of the kiln in order to ascertain its progress; for although, from its outward appearance, they may imagine the fire to be extinguished, it yet may be burning fiercely in the interior; and if the air be admitted, the main force of the fire will draw to that hole, where it will blaze out, and thus the work will certainly be retarded, if not entirely stopped. Although the process is very simple, when well understood, yet, like everything else, it requires some experience, and mistakes are continually made by workmen who, not being already acquainted with the practice, are apt to burn the clay into lumps. It is, indeed, difficult to describe the operation with sufficient accuracy to enable those who have never seen it done to burn properly. Men who understand it can, however, be easily procured from some district in which it is common, and, with the instruction of one of these, any of the labourers on the farm can soon be rendered sufficiently expert; but, without such assistance, it would be inexpedient to attempt it.

BURNING IN HEAPS.

Another common mode of burning earth, is to dig up the surface of banks and headlands, or old borders, and, when dry, to cart it to a heap. The practice then is, to lay a foundation of earth, some inches thick, then haulm, straw, dry weeds, and a few bushes, whins, or anything of the kind, upon which the pile is raised in the form of a cone, and enclosed with a wall of turf in the manner already described. When fuel is scarce, an experienced burner will light a small heap, and increase it to almost any extent, by pulling down part of the wall, drawing out a portion of the fire, and adding fresh earth. They are not uncommonly carried to 12 yards in diameter, and in that case generally contain about 100 loads of ashes, at 36 bushels to the load *. The digging and burning is stated to be done, in Suffolk, by contract, at from 6*d.* to 1*s.* per chaldron; but the carting, filling, and spreading will cost, on an average, 1*s.* per load; or, according to the following estimate, on 100 loads, as follows † :—

	£.	s.	d.
Labour in digging and burning	3	15	0
Filling, 1*s.* 6*d.* per score, 7*s.* 6*d.*; and carting, with two carts and three horses, 16*s.*	1	3	6
Filling and spreading, after burning, at 3*d.* per acre .	0	15	0
Carting, and laying out over two acres . . .	0	16	0
Total, per 100 loads . . .	£6	9	6

A nearly similar method is also much practised in Suffolk, where the earth is burnt in mounds, and it is called *clod-burning*. The clods are raked together in small heaps of from four to eight bushels, at a rod distance, and burnt by placing them upon a small quantity of haulm, or straw; but this should be done very expeditiously, on the fire being properly kindled, as otherwise it would be exhausted before a sufficient quantity was heated; for which reason it is proper to light them early in the day, that they may be well covered before sun set. This, however, differs from paring and burning, as it is not requisite that any weeds, or roots of weeds, should exist in the soil, for the real earth alone burns or chars sufficiently; and as the smaller the heap, the less is the earth calcined, it is thought by some that the better is the manure. The idea is, however, probably erroneous; for these small heaps are so quickly burned, that what is on fire at noon may be completed before night: if despatch be an object, that may be attained by employing a greater number of hands, whereas large piles cannot be effectually prepared without more constant attention and delay; but, like the process of kiln-burning, this operation also requires some experience to carry on the work expeditiously, and to burn close. It is done by contract, and is stated, by Mr. Poppy, to cost, on tender soils, from 12*s.* to 14*s.* per acre, and to require half a load of haulm or straw. The expense, and the quantity of ashes produced by the clods, differ, however, with the nature of the land. The more rough or tenacious the soil, the larger will be the clods: those from one to three inches over will produce from 25 to 35 chaldrons per acre; if larger, and abundant, perhaps double that quantity ‡; and land broken up after tares or seeds will frequently produce 100 chaldrons or even more if required; but from 40 to 50 is

* Essay on Cheap Manure, Anon., 2nd edit., p. 47.

† Poppy, on Burning Clay, p. 6.

‡ Four-pronged forks are used to throw in large clods; the smaller ones are raked together. The rakes have handles 8 feet long, the heads 22 inches, and 12 teeth 4 inches long, heavy and strong, having an iron collar at each end of the head, to keep it from splitting; the shovels should be broad, hollow, and light.

generally considered ample. It should, however, be remarked, that a greater quantity may be collected, burnt, and spread, at a less average cost than a smaller.

Although the method of burning in heaps has the merit of simplicity, yet the plan is objectionable, because this method of managing the fire subjects it, in many instances, to be either extinguished, or to burn with such increased force as to convert any portion of the earth which consists of clay into mere brick; besides occupying increased time and labour, and occasioning an additional charge for cartage. It does not produce such good ashes as when the earth is calcined in a close kiln: neither has the same quantity of fuel equal power; for, by the erection of walls, the heat is effectually retained, and will continue for a long period after the fire has been extinguished; whereas, in these round heaps, the air having full power over every part of the surface, the internal heat is sooner checked, and the smothering process—which is considered essential to the value of the manure—cannot be so perfectly accomplished. Besides, as the walls are ultimately converted into ashes, their cost only amounts to the trifling additional charge of the labour of their erection.

BURNING WITH LIME,

Is also a plan which has been adopted with much apparent advantage by Mr. Curwen, both when applied to the surface soil, and to clay taken from the under stratum. The method is as follows:—

'Mounds of 7 yards in length, by 3½ in breadth, are kindled with 72 bushels of lime; first, a layer of dry sods, or parings, on which a quantity of lime is spread, mixing sods with it,—for he doubts whether clay can be properly converted into ashes without a mixture of surface soil, as it is in that case either calcined, or not sufficiently burned. Then a covering of eight inches thick of sods, on which the other half of the lime is spread, and covered a foot thick; the height of the mound being about a yard.'

'In twenty-four hours it will take fire. The lime should be taken immediately from the kiln; but it is better to allow it to ignite itself, than to effect it by the operation of slaking by water. When the fire is fairly kindled, fresh sods should be applied; and it is recommended to obtain a sufficient body of ashes from the sods before any clay is put upon the mounds. The fire naturally rises to the top; it takes less time, and does more work to draw down the ashes from the top, and not to suffer it to rise above six feet.'

Mr. Curwen also says, 'That the former practice of burning in kilns was more expensive, did much less work, and in many instances calcined the ashes, and rendered them of no value*.' On which it may be observed, that, with regard to the expense, the difference in labour in favour of the practice of burning with lime cannot be very material, for it only consists in the charge of raising the walls, with a little more attention to the fire, and will not amount to so much as the cost of the lime. As to the amount of work performed, he furnishes no data upon which an estimate can be founded; but, with respect to the management, there can be little doubt that the operation with lime is the most simple. It may therefore be attended with considerable advantage in those districts where lime can be procured at a moderate price, as it must be supposed 'that the lime adds its full worth to the value of the ashes.'

* *Farmer's Magazine*, vol. xvi. p. 411.

APPLICATION.

The chief point to be observed in the *application of these ashes* is—that they be thoroughly pulverised, or at least brought into a state as nearly resembling powder as may be found practicable; and this cannot be effected unless the heat be so confined as to prevent it from spreading to a flame, for in that case the clay will be assuredly burned to bricks, and to this mistake many failures in experiments have been attributed. The term '*ashes*' may, indeed, in this sense, be deemed somewhat misapplied; but we know not any other that will more clearly convey our meaning, though our readers will doubtless comprehend that the process is to stop short of that state of hardness which is produced by the brick-kiln. In effecting this, care should be taken not to burn clay that has been much sun-dried, for if put on the kiln in that state, it will produce lumps which will not be easily broken, even by a mallet.

The *best time for beginning the operation* is when the weather sets in fair, in spring; but the land should also be well cleaned, and brought into fine tilth, in order to allow of the soil being intimately blended with the ashes. When laid upon arable land, they should therefore be brought, as nearly as possible, into a state of powder, if intended for corn; but when applied to green crops, they may be used somewhat coarser.

Regarding the species of earth to be burned—strong clay is the best for the purpose, for its adhesive properties being destroyed by the process, it will become good manure for land of the same sort, and will be found advantageous to ground of almost any description; but when light soils are burned, (a practice, however, which we have shown to be in general disadvantageous,) the ashes are not calculated to apply to similar land, but should be laid upon strong clays or tenacious loam.

The *quantity of ashes to be applied to the land* may be varied according to its quality. Viewing its effect as chiefly mechanical, the more adhesive the soil, the greater will be the amount required: for, as strong clays are apt to run together after heavy rains, and to retain the water upon the surface, instead of allowing it to penetrate to the pan below, the larger the quantity of matter which may have the effect of rendering them porous, the better; and its application to such ground hardly admits of any limit. In no case will it be found prejudicial; and, from what may be gathered from the foregoing experiments, as well as from the information of other practical men, we think that it should never be laid on any land in a less quantity than 800 bushels per acre.

Chapter XVIII.

MINERAL MANURES *continued*

SALT—NITRE.

Salt of various qualities is produced in several countries, and known according to the different sources from which it is obtained—whether from the waters of the sea, from salt-springs, or from mines. It cannot, therefore, be strictly called a mineral, unless when found in the state of rock-salt; yet, partaking of the nature of that fossil, and not having here to consider its effects in any other light than as a manure, we deem it unnecessary to enter upon any discussion of its peculiar properties when manufactured, and shall, therefore, confine our observations to its effects upon the soil.

In consequence of the former excise duty, which has been only lately taken off, the use of salt, as manure, has been upon too limited a scale to justify any positive conclusion regarding its merits *. Indeed, like almost every question connected with experiments on agriculture, this has given rise to opinions so utterly discordant, as to leave the decision of its value in much the same doubt as when it was first broached. Statements have been brought forward by many eminent farmers, which, though made upon apparently strong grounds, and without any doubt of their candour, yet broadly contradict each other; and the evidence produced before the Board of Trade in 1817, and before a Committee of the House of Commons, appointed, in 1818, to consider the subject of the salt duties, although certainly in most instances loudly commendatory of its employment for the general purposes of husbandry, has left the subject of its application to the land in nearly similar uncertainty.

It was represented as operating as a manure upon arable land by its tendency to promote putrefaction, as well as by stimulating the powers of vegetation through its absorption of moisture from the atmosphere; as being destructive of weeds and insects, and a preventive of rust; as improving the herbage of grass-land, destroying the moss, and rendering fodder palatable which would be otherwise refused by cattle; and as acting as a condiment conducive to the health of all animals. The abandonment of the duty was therefore hailed by its advocates as a special boon to the agricultural interest, and it has certainly been proved in numberless instances to have been successfully applied to some soils under peculiar circumstances; yet, except in cases where its use has been rather governed by local facilities than by any conviction of its real value, farmers do not appear to have generally availed themselves of its advantages as a manure, though it is gradually creeping into use for live stock. It is, indeed, admitted on all hands to be noxious to the whole tribe of slugs, and worms of that description, though we have yet no proof which can be relied on of its preventing the ravages of the fly on turnips; its effects in correcting the faults of sour pasturage and spoiled fodder seem also to rest upon grounds which can hardly be doubted †. There are also proofs of its power in checking the rust in corn; for although that disease has been generally attributed to the varying changes of the atmosphere, yet it was stated in the evidence of Dr. Paris before the Salt Committee, that it was the practice of many farmers in Cornwall to spread about 30 bushels of salt, the refuse of the pilchard fishery, weighing 56 lbs. each, per statute acre upon their land, a fortnight previous to the sowing of turnips; and they all agreed that they never had any rust on the following crop of wheat where this was adopted, though before they were greatly affected by it. In the course of a very minute inquiry into the causes of rust, undertaken

* The duty amounted to about 30*l.* per ton, the original value being under 20*s.*; and although, in the preparation of the brine, there is a refuse part formed by the separation of the grosser particles from the pure salt, and which was for a long time sold to the farmers duty free, yet this was afterwards prohibited, and the whole of the foul salt, which was produced in one of the districts of Cheshire to the yearly amount of near 120,000 bushels, was carefully swept away after the process of manufacture was completed, and then in the presence of the exciseman thrown into the river Weever.

† Salt destroys vermin by making them void the contents of their bodies; such evacuations being too powerful for them to withstand.—Lord Dundonald on Chemical Agric., p. 138. See an experiment in proof of this, in the Farmer's Magazine, vol. xviii. p. 440, in which it is stated that grubs, full of food, when placed in fresh earth in which some young roots of grass were transplanted after being very slightly pickled with common salt, were in 24 hours reduced to mere skins, and two out of three dead. —Also Johnson's Observations on Salt, 8th edit., pp. 8 and 10.

some years ago in this country, and afterwards continued at different periods on the Continent, it also appeared, that it was never experienced in the immediate vicinity of the sea, unless when the ground was greatly over-manured; and that when sea-ooze or sand was employed as manure, it was prevented *. This, however, does not apply to the practice of *steeping seed-wheat*, which can only have the effect of purifying it, but cannot, it is presumed, prevent the grain from afterwards receiving infection from the air, and which, indeed, applies rather to *smut*, than to *rust* or *mildew*. Its influence in forwarding the putrefaction of manure depends upon the quantity in which it is employed †; and although its property of absorbing moisture from the atmosphere, and retaining it in the ground, constitutes, perhaps, its chief value, when applied to light soils and in dry summers, yet, on heavy land and in wet seasons, its power seems to have little effect: it has therefore fallen into disrepute with many persons who have tried it without due attention to these circumstances. It is, indeed, evident, that the extravagant expectations entertained of it by some, and the disappointment experienced by others, have been occasioned by the contingent nature of its character, which, depending not alone upon the amount in which it is used, but also on the quality of the soil and on the state of the weather, must render it occasionally ineffectual. That it contributes to the health of animals is a fact now universally granted; though its specific virtues, when administered in different quantities to stock of various species, age, and condition, have not been yet sufficiently ascertained, nor have we now to consider of its employment for that purpose. We therefore neither accord in all that has been assumed in its favour, nor yet in its disproval; and limiting our examination to its operation upon the land, we shall now state some minutes of the experiments which have been tried, from which every intelligent farmer may draw his own conclusions.

EXPERIMENTS ON SALT.

In Holland s Survey of Cheshire, instances of its influence in destroying weeds and insects are mentioned; and its *effects on fallows* are thus detailed:—

'To account for the difference of effect arising from the application of salt as a manure, we may refer principally to two causes: viz., a difference in the mode and degree of application, and a difference in the nature of the soils on which experiments have been made. The first of these causes must undoubtedly have the most important influence. Regarding its action upon vegetable matter as that of a stimulus, it is natural to conclude that its effects must be varied very greatly by the proportion applied. If used in large quantity, it has a tendency—like every other excessive stimulus—

* See the Report of the Committee, p. 30; also Cuthbert Johnson's Essay on Salt, p. 49; Sir John Sinclair on the Rust in Wheat, Farm. Mag., vol. xix.; Ibid., vol. xx. p. 435; and Sir Thomas Bernard on Salt, p. 278. It is also stated in Dr. Thomas Thompson's System of Chemistry, that "in the water given to plants which are natives of the sea-coast, a minute infusion of common salt would consult the natural circumstances of that description of vegetables, and that they languish without it;" which is confirmed by Professor Davy's experiments on the effect of different salts conveyed in water to the roots of plants, as recorded in his Elements of Agricultural Chemistry, 4to., p. 296.

† If used in large quantities, it is antiseptic; but if moderately mixed up with composts, it has been found to promote the putrefaction of the vegetable and animal substances which they contain. The quantity has, indeed, been stated as high as a ton to the acre; but this is either foul salt, which has been used in the fisheries, or the refuse of brine which has been manufactured, and which cannot be estimated at more than one-half, or perhaps one-third, of the weight of pure salt.—Sir H. Davy, Elem. of Agric. Chem., 4to. p. 295; Cheshire Report, p. 237.

to disorganize and destroy the vegetable substances with which it comes into contact: when a smaller proportion is applied, or when it is mixed up into a compost and employed in this state, it may be regarded, by the moderate stimulus it gives to the action of the vessels in the plants, as a promoter of vegetation, and consequently as a valuable manure. In this respect its effects are analogous to those produced by a similar application of lime; the influence of both substances upon vegetation being varied greatly by the proportions employed. In some instances, as when the land is lying in fallow, it would appear probable that the application of salt might be productive of advantage, by effecting the destruction of all useless vegetable and animal matter. Its quantity would also be so far diminished by the time the seed was put into the ground, as to fit it for affording that degree of stimulus which is most beneficial to vegetation; for, by being mixed sufficiently with the soil before the grain is sown, it adds a strong nutriment, and ensures the best of crops.'

To this some observations to the following effect are added by Sir Thomas Brooks, in his tract upon the Salt-duties, from information obtained through Mr. Hollinshead, of Chorley, in Lancashire, a gentleman who devoted a great portion of his long life to a scientific and practical inquiry into the uses of salt as a manure.

With regard to the *quantity to be applied* *, he observes, that 'When a farmer intends to fallow a piece of ground, he ought first to sow it with such a quantity of salt as would be sufficient to destroy vegetation,—namely, 40 bushels per statute acre, which, by cutting and dividing the viscous substances in the earth, would reduce it into a proper state to become food for plants. The farmer must take notice that this salt is to be sown on the ground some time before he begins to work his fallows with the plough: the autumn will be the most proper season, in order to give the salt sufficient time to destroy the grass and other roots upon it, before he begins to work it. The salt, being thoroughly mixed and incorporated with the soil during the spring and summer following, will, while the land is under the plough, be reduced, by the time the seed is sown upon it, to that strength which is the most proper for effectually and vigorously assisting and supporting vegetation when the grain is in the ground. This method of sowing the intended fallows with salt will therefore serve very much to lessen the labour of the husbandman in working his grounds; for the tough and adhesive clods and lumps, which are generally so troublesome, especially upon clayey soils, will be so completely broken and dissolved by the operation of the salt as to give much less obstruction to the harrow at the first working.' Such is the practice which he recommends on deep loamy dry soils; but, for other corn lands, sown in the usual way after a spring ploughing, he advises the spreading of 16 bushels of salt per acre immediately after the grain is covered in by the harrow, and afterwards sowing 10 bushels per acre annually, by which means he affirms that 'these lands will be ever after considered exceedingly productive.'

In the Report of the Committee of the House of Commons, various experiments are also stated, in which salt has been applied to fallows: one, representing the crop as nearly treble in proportion to the rest of the same field, and both the grain, and the succeeding crop of clover, as of a superior description; but it appears from the same report, on the testimony of respectable individuals, that in three of those cases it was of no use what-

* It should here be remarked that the quantity mentioned applies to *foul salt*, the strength of which is not more than generally one-third, or at the most one-half, of that of *pure salt*; if the latter be used, it should therefore be diminished in a similar proportion.

ever as manure. In two of the experiments, however, the quantity has not been distinctly stated; and in the third, which was made with great accuracy, the utmost amount laid upon the land did not exceed 10 bushels in one instance, and 12 in another *; whereas nothing less than from 30 to 40 bushels of foul salt per acre can be employed upon fallows with any prospect of success.

On its *application to corn*, the following experiments *in the field practice* are taken from Mr. G. Sinclair's Prize Essay, communicated to the Board of Agriculture, in 1820 †:—

WHEAT AFTER BARLEY.

Soil, without manure	produced	16½	bush. per acre.
——, dressed with 11 bush. of salt . .	„	22¼	„

WHEAT AFTER FLAX.

Soil, with 11¼ tons of spit manure . .	produced	16½	bush. per acre.
——, with 6½ bush. of salt . . .	„	23¾	„

WHEAT AFTER BEANS.

Soil, without manure	produced	11⅛	bush. per acre.
——, with 6½ bush. of salt on the surface .	„	21	„

WHEAT AFTER PEAS.

Soil, without manure	produced	16	bush. per acre.
——, with 6½ bush. of salt with the seed . .	„	17¾	„
——, with 6½ do. dug in with the seed .	„	23¼	„
——, with 6½ do. and 6½ bush. of soot dug in	„	20	„

BARLEY AFTER TURNIPS.

Soil, without manure	produced	12	bush. per acre.
——, with 5½ bush. of salt applied before sowing	„	28⅓	„
——, with 11 do do. .	„	28¾	„

The experiments were unfavourable to the use of salt on *oats*, so far as they were then carried; but the quantity applied appears to have been too large to admit of a fair trial of its real merits.

Mr. Sinclair also mentions experiments on spaces of 36 feet square, manured with salt at the rate of 5½ bushels per acre, drilled with *Talavera wheat* on the 5th of November, and reaped on the 2nd of August, which respectively yielded produce at the extraordinary rate of 91, 73, and 82 bushels per acre, when mixed, in the first instance, with the soil four inches deep, before sowing; sown, in the second, with the seed; and in the third, simply applied to the surface. On which he observes, that the result of this extraordinary produce upon these small plots of ground must not be considered erroneous, for that he has seen produce equal to upwards of 23 quarters an acre, although one-eighth of the ground was without plant. Such instances are, no doubt, rare; but experiments are usually conducted with greater care on small spots of ground than in fields of larger size; the quantity of land is accurately measured, the soil generally of superior quality, and the product collected to the last grain; whereas we all know that, in the common practice, there is much waste both in the reaping and the carrying of grain, as well as much ground lost in roadways and fences. The same results cannot be expected as in more extended operations, but such trials are valuable as

* See the Report of the Salt Committee, pp. 152 and 162

† This Essay contains tables of the result of a great variety of experiments upon the comparative use of salt, lime, soot, dung, and oil-cake; as well as trials of the effects of salt upon wheat, when applied after various preceding crops, and afford much curious and important information.

affording evidence of the comparative advantages arising from different kinds of manure.

To this we have to add a recent communication from Mr. Sinclair, in reply to an application to him for some further information on the subject, in which he says, 'that the facts here stated may be depended upon; that his opinion of the utility of the manure remains unaltered; and to these experiments he refers, as the fullest evidence of his convictions on the subject.' But, with that candour which distinguishes every man whose object is unprejudiced investigation, divested of any bias to the promotion of a favourite object, he adds, 'that it is not free from anomalies, which time and further experience can alone reconcile.'

On the subject of *wheat and barley*, Mr. Cuthbert Johnson also mentions, in his Observations on the Employment of Salt, that on his own farm, at Great Totham, in Essex, he had increased the produce of the former, upon a light gravelly soil, to the extent of 5½ bushels per acre, by the use of 20 bushels of salt. On the same land, he also states the result of the following experiments on wheat to have been:—

Soil, without any manure for four years .	roduced	13 bush.	26 lbs.	per acre.
——, manured with stable-dung to a previous crop of potatoes . .	,,	26 ,,	52	,,
——, with 5 bushels of salt per acre, and no other manure for four years .	,,	26 ,,	12	,,

Another Essex farmer, Mr. James Challis, of Panfield,—whose soil is described as being of a loose, hollow description,—had a dressing of salt put on it in November, after the wheat was sown, of about 14 or 15 bushels per acre, which is also stated to have produced at the rate of six bushels per acre more than that which was not dressed, and was considered to be 20*s*. per load better in quality. Several experiments, indeed, have shown the grain to be heavier, in proportion as the quantity of salt was larger. Other accounts are likewise given of the produce of wheat crops when manured with stable-dung, in comparison with salt, which are so largely in favour of the latter, that we fear to repeat them, lest they should appear to throw a doubt over the accuracy of the statement *.

On the subject of barley dressed with salt, Mr. Ransom, of Sproughton, in Suffolk, says that 'it presented no difference of appearance to the rest of the field, until a fortnight before harvest; the salted crop was then brighter, and about one week forwarder than the rest of the field; and the following were the results when carefully cut and measured:'—

Soil, without any manure . . .	produced	30 bush.	per acre.
——, dressed with 16 bush. of salt per acre, in March	,,	51	,,

Regarding *root crops*, Mr. Cuthbert Johnson also mentions his having been informed by Sir Thomas Acland, that salt has been laid upon his farm at Killerton, in Devonshire, at the rate of 40 heaps of earth to the acre, in each of which heaps 33 lbs. of salt were well mixed, and let to lie a fortnight before being spread upon the land, which was afterwards ploughed three times, and then sown with mangel-wurzel, which had roots weighing 32 lbs. each. A field was also dressed for turnips; one-third with salt prepared in the same manner, one-third with lime, and the remainder with hearth-ashes. When the seed came up, the turnips appeared most promising where the hearth-ashes were; but, after the first month, they did not grow so fast as where the salt or lime was; after that time, the turnips where the ground was manured with salt grew faster, the green looked stronger, and at the end of the season they produced the best crop.

* See a publication by the Rev. B. Dacre, entitled 'Testimonies in Favour of Salt as a Manure and a Condiment for Cattle.'

To this he adds the testimony of Mr. Collyns, of Kenton, in Devonshire, who says that 'Barley and oats which used to yield only 15 to 20 bushels per acre, now yield from 40 to 45; the wheat is also much improved in quality, but not so much as was expected in quantity. Thirty-five bushels of wheat have been produced from an acre, dressed with 10 bushels of salt; and from the same field last year, after the same quantity of salt, 140 bags of potatoes. This year, however, it has only produced 20 bushels, though again manured with 10 bushels of salt; but the quality is very superior, and the root of clover in it is very fine and luxuriant.'

From a communication by Mr. Davies Giddy on the culture of turnips, it appears that on a part of a field which had been previously exhausted, half a crop was produced, but totally failed on that part where the ordinary manure was laid without salt. In another instance three acres of land, which on the preceding year had borne a crop of wheat not exceeding 12 bushels to the acre, were ploughed before Christmas, and brought into fine tilth by the midsummer following. On each acre were sown 20 bushels of salt, excepting that two ridges, towards the middle of the field, were purposely left without it; and on these the turnips totally failed, though the remainder of the ground produced an abundant crop. It is further instanced, that four acres of land, completely worn out by successive tillage, were sown,—three acres with salt, at the rate of 25 bushels, and the remaining acre with 18 bushels, without any other manure; the crop was in general a good one, but was visibly the best where the greatest quantity of salt had been used *.

Mr. Hare, of Beaconsfield, in Buckinghamshire, has used salt at the rate of 2 cwt. per acre on a large field of very gravelly soil, part of which was left without any manure, and the remainder dunged as usual; yet the turnips produced on the salted acre were just as good as those raised from any other part of the ground. In the following year, on another field of the same quality, he manured the whole of it with farm-yard manure, adding to one acre of the field thus manured 2½ cwt. of powdered rock salt; and on this salted and manured acre, he had a larger and a finer crop of turnips than was produced upon any other field of equal extent in the whole parish. Sir John Sinclair has also tried it, on a small scale, with equally good effect †.

Some comparative experiments have been likewise made with *salt and soot*, as well as with stable-dung, when applied in different proportions to carrots and potatoes, which produced crops at the following rates per acre. Those by Mr. G. Sinclair, of Deptford, were:—

		tons.	cwts.	lbs.
No. 1. Carrots sown without any kind of manure	produced	23	9	107
2. 13½ bush. of salt mixed and sown with the seed	"	30	12	79
3. 6¼ do. dug in previous to sowing	"	44	14	17
4. 13½ do. dug in previous to sowing	"	31	13	40
5. 6¼ do. and 6¼ bush. of soot, dug in previous to sowing		40	4	97

Those of Dr. Cartwright, of Tunbridge, upon a ferruginous sand, brought a due texture and consistence by a liberal covering of pond mud, were:—

Potatoes, without any manure	produced	157 bush.	per acre.
———, with 9 bush. of salt per acre	"	198	"
———, with 8 do. and 30 bush. of soot per acre	"	240	"
———, with 30 bush. of soot per acre	"	182	"

The effect of salt mixed with soot is remarkable ‡; the roots of the

* Annals of Agriculture, vol. xxvii.

† See his Code of Agriculture, 3rd edit., note in the App., p. 40.

‡ Dr Cartwright remarks, 'that there is no reason to suppose that the effects of salt,

carrots in No. 2 were the smallest; in No. 4, the largest; and in No. 5, the healthiest. The experiments made by Mr. G. Sinclair upon potatoes, planted in a soil composed of three-fourths siliceous sand,—both without any kind of manure, and at the rate of 13½ and 6½ bushels of salt with the seed, as well as with 13½ bushels mixed with the soil—left no room to doubt of the advantage of 13 bushels per acre, applied to the land previous to the planting, over the other modes of application; but the superiority in either case was not very great.

Those of Mr. Cuthbert Johnson, upon a light gravelly soil, were:—

Potatoes, without any manure . . .	produced	120 bush.	per acre.
———, with 20 bush. of salt per acre, laid on in the previous September . . .	"	192	"
———, with stable dung at the time of planting	"	219	"
———, with do. and 20 bush. of salt .	"	234	"
———, with 40 bush. of salt alone; 20 laid on in September, and 20 in the spring, after the sets were planted . . .	"	192½	"
———, with 40 bush. of salt, as in the last experiment, and also with stable dung .	"	244	"

The trials made by Mr. Forbes, of the Pinefield Nurseries, near Elgin, upon *salt, when compared with farm-yard manure*, as dressings for root crops, however, tend to show the latter to be in every instance superior; and also to prove that when used in a large quantity it is injurious to vegetation, as it will be seen by the annexed table that the crops were lighter in proportion as the amount of the salt employed was larger. It was laid on in the proportions there stated *per Scots acre*, and an equal measure of land was moderately dunged; but though it appears from the produce that only a very small spot of ground was devoted to the experiment, yet that will not invalidate its accuracy.

Salt, at the rate of	2 Tons.		1½ Ton.		1 Ton.		½ Ton.		Dung.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Onions . .	8	0	8	4	10	8	15	0	20	0
Carrots . .	13	0	17	0	20	8	24	0	28	0
Turnips . .	30	0	32	0	30	0	27	0	34	8
Potatoes .	11	0	11	0	12	0	14	0	24	8
Mangel-wurzel	39	0	40	0	41	0	40	0	40	8 *

Salt has been tried against farm-yard manure after the rate of 15 tons per acre upon a light sandy soil, and no difference was observed in the crop of turnips. It has also been mixed with the seed of turnips, and sown in drills at the rate of 14 bushels per acre, but the seed did not vegetate, owing, as it was supposed, to its being too closely combined with the salt; for the ground having been again ploughed and harrowed, fresh seed was sown broadcast, which grew and flourished. When top-dressed with salt they have also succeeded, though no effect has been observed

when combined with soot, were produced by any known chemical agency upon each other. Were I to guess at the producing cause, I should conjecture it to be that property of saline substances by which they attract moisture from the atmosphere; for I observed those beds on which salt had been used were visibly and palpably moister than the rest, even for weeks after the salt had been applied, and this appearance continued till rain fell, when, of course, the distinction ceased. This property of attracting moisture had greater influence possibly on the soot than on any of the other manures with which it was tried, as soot, from its acrid and dry nature, may be supposed to require a greater proportion of water to dilute it than those substances which contain water already.'—Communications to the Board of Agric., vol. iv. p. 370.

* Gardener's Magazine, June, 1828.

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regarding their prevention of the fly; and when spread under furrow, the crop was eaten off by the beetle *.

Although the experiments on the application of salt to *meadow and pasture land* generally agree in their representation of improvement having been thereby effected in the quality of the herbage, yet we have to regret that they are so few, and so inconclusive, as not to afford any decisive proof either regarding the comparative weight of crops thus manured, the season in which it may be the most advantageously applied, or the quantity in which it should be laid on different soils. In the Cheshire Report it is indeed said, that eight bushels of refuse salt, per acre, having been spread, in the middle of October, on a piece of *sour rushy ground*, and sixteen bushels on another part, the vegetation in a short time disappeared totally; and, in the month of April following, not a blade of grass was to be seen. In the latter end of the month of May, however, a most flourishing crop of rich grass made its appearance on that part where the eight bushels had been laid; in the month of July, the other portion produced a still stronger crop; the cattle were remarkably fond of it; and during the whole of the ensuing winter, and for several years, the land retained, and still exhibited at the time this account was written, a superior verdure to the surrounding closes †. This, however, probably alludes to *pure salt;* for it is stated in Sir Thomas Bernard's pamphlet, that sixteen bushels of *foul salt* having been laid, in the month of April, upon a field, which, for many years, had borne a very dark-coloured dry kind of grass, which neither horses nor neat cattle could relish, had ever since that time borne herbage which was perfectly green, and upon which stock of all kinds throve remarkably.

The statements of its effects upon the *artificial grasses* are also too meagre to be relied on, though the application of six bushels of salt to an acre of red clover, upon a good turnip soil, is said to have increased the produce, at the very least, 10 cwt. per acre; the aftermath, also, proportionably good, the cattle eating it down close, and in preference to every other part of the field ‡. *Hay of all kinds,* when coarse, or injured by the wet of an unfavourable season, has, however, been very generally proved to be so far improved in its quality by the addition of a quantity not exceeding about a peck of pure salt to a ton of hay, thinly sprinkled over the layers in the stack, as not merely to be rendered palatable to stock, but in many cases to be consumed with even superior relish. When the crop has been much exposed to rain, it checks fermentation, and prevents mouldiness §.

We have refrained from reciting the arguments which have been employed to urge the use of salt as a manure, because we think it should rest upon practical proof, rather than upon theory, however specious; yet we cannot help remarking, that corn grown in the neighbourhood of the sea is distinguished by its superiority of weight as well as colour; and that salt marshes are known to possess highly fattening properties when fed by cattle. It is, therefore, only reasonable to suppose, that the application of salt to the land may be productive of similar effects, and we have taken the foregoing extracts chiefly from those statements of experiments which have resulted in its favour, because they hold out the promise of its being advantageous; for every kind of manure is of such great importance to agriculture, that we wish to induce farmers who have not already experienced its effects, to make repeated comparative trials of it upon their

* Cuthbert Johnson's Essay on Salt, 3rd edit., pp. 70, 71.

† Holland's Survey of Cheshire, p. 238

‡ Cuthbert Johnson's Observations on Salt, &c., 1st edit., p. 10.

§ Sir Thomas Bernard on Salt, p. 276. Surveys of the N. R. of Yorkshire, p. 177; and of Derbyshire, vol. ii. p. 182

own land. We say *repeated*, because we are convinced that nothing short of a continued series of trials can be decisive of its merits; and *comparative*, because in no other way can any safe conclusion be drawn regarding its competition with other manure. We must also remind them, that its cost is now so trifling as to put it in every man's power to satisfy himself of its value at a charge that is not worth mentioning; and that any one who fails to do so must be regarded as seriously inattentive to his own interests.

It would, however, be unfair to withhold all that has been written in opposition to its use; and among those treatises which are best entitled to attention on that side of the subject, are some prize essays in the papers of the Highland Society of Scotland, on 'Experiments with Salt as Manure,' which, though they leave the question of its value still in doubt, yet rather tend to throw discredit upon its employment; for, notwithstanding one of these writers—who is a farmer of experience—expresses himself in support of it, yet others are decidedly unfavourable. One of these reports, indeed, which is both minute and apparently accurate, states that it was tried upon crops of potatoes, oats, barley, and turnips, as well as upon natural and cultivated grass. Refuse salt was applied, mixed with ashes in the proportion of three-fourths of the former to one of the latter, and laid on at various rates from sixteen to thirty bushels per acre, both drilled in, and as a surface dressing upon land in some parts unmanured, and in others well spread with the best farm-yard manure. On the oats and barley, however, no perceptible difference was occasioned by its use; and on all the other crops it appears to have been injurious. The deficiency in the amount of potatoes produced upon that part of the ground which was only salted was indeed comparatively enormous; for, in two instances in which it was laid in the drills, the crop was only one-third of that upon which dung was used alone *.

In a paper published in the second volume of the Communications to the Board of Agriculture, the writer relates several experiments, in all which the application of salt, in various quantities, both on arable and pasture, was either completely or in a great measure unsuccessful.

Some statements to the same effect have likewise been lately published in the British Farmer's Magazine †, which show—

1st. That 24 bushels, equal to 1 ton of rock-salt, were ground into powder ‡, and on the 10th of April were sown on four separate roods of meadow land, at the rate of one-fourth, one-fifth, one-sixth, and one-seventh of a ton to the acre: on the 21st it appeared to have destroyed the grass on that part where the greatest quantity had been, but that was not the case eventually, as it afterwards recovered.

2nd. On the 14th of April it was sown on three equal portions of land, at the rate of one-fourth, one-fifth, and one-sixth of a ton per acre, on fallow, and on wheat growing, which was afterwards sown with red clover: on the 21st the weeds appeared to be destroyed, but at harvest time were like the rest.

3rd. At the same time it was laid at the rate of one-sixth of a ton per acre, on some fallow, which was afterwards sown with oats and clover.

4th. On the 25th of April, on the third ploughing for fallow, it

* See the Proceedings of the Society, from November, 1820, to December, 1823, vol. vi.

† No. ix. vol. ii. p. 427.

‡ When broken into small pieces, it runs through a corn-mill, and can then be ground as small as may be desired.

was spread at the rate of one-fourth and one-sixth of a ton per acre, worked and manured as the rest.

5th. At the same time, and the same rate, on the same ploughing, on some land that was sown with rape.

The above experiments were tried on a strong loamy clay, with a clay subsoil, and the result of the whole proved that they were not attended with any advantage.

6th. On the fifth ploughing of a good loam, it was laid at the rate of one-fourth and one-sixth of a ton for turnips, which had been regularly dunged, some of it being placed in the ridges before, and some after the manure. Some potatoes, on the same land, were also similarly treated; but no difference whatever was apparent in their favour.

These trials appear to have been made under the personal superintendence of the writer, and the editor vouches for the accuracy of the statement. The result is certainly in extraordinary contradiction to those of other experiments, nor is it possible to account for it in any other way than by attributing it to the nature of the soils on which they were made. If to be finally relied on, it would prove 'that the use of salt, as a manure, is of no value on strong or loamy soils;' but we are so far from agreeing to that conclusion, that we think it only affords additional proof of the propriety of every farmer judging only for himself, through his own experience.

APPLICATION OF SALT.

From what we have thus stated, it must be apparent that nothing decisive has been ascertained regarding either the quantity or the season in which salt should be laid upon the land. It appears, however, that its effects are most visible and satisfactory when applied to hot, dry soils, and in very warm summers; but on cold, wet land, and in rainy seasons, or under a humid climate, its powers seem to become neutralized, and of little value. We are of opinion that, on arable land, it will be found more advisable to lay it on before sowing, than either with the seeds, or afterwards as a top-dressing. If applied, for instance, to a clover ley, either a few weeks before seed-time, or immediately after the first crop is off, it would effectually banish the slug; and it has been justly observed that, if all stubbles (not laid down with seeds) were to receive a slight dressing of salt before winter, it would not only tend to keep the land free from the slug, but probably also otherwise benefit the soil *.

In preparing the land *under the fallow-process*, it has been recommended to spread from 30 to 40 bushels per acre for the purpose of destroying the roots and insects in the soil, and breaking all the tough and adhesive clods which are found to be so troublesome in working the ground. This should be done in autumn, some time before the first ploughing; as the salt being thoroughly incorporated with the soil during the spring and summer following, its strength will be so materially reduced by the time when the seed is sown, that instead of injuring, it has been found to promote vegetation †. With regard to the destruction of insects, that object can, however, be attained with half the quantity; and we must again caution our readers against the indiscriminate recommendation given of the use of salt, without distinguishing whether it is *foul* or *pure*: on the application of 40 bushels of the latter, vegetation ceases.

* British Farmer's Magazine, No. xiv. p. 66.

† Hollinshead on Salt as a Manure, 2nd edit., p. 17. Sir John Sinclair's Code of Agriculture, 3rd edit., p. 38.

When *applied in composts*, it is said to have been found more effectual than lime. It has been tried in Cheshire on barley and seeds, and greatly exceeded the most sanguine expectations that had been formed of it. A quantity of refuse salt having been also mixed up with earth, and another portion of the same earth with lime, the vegetation of that part of the field upon which the salt was laid was by far the healthiest and the most vigorous*. In Ayrshire it has been mixed with 32 bushels of lime-shells, and either spread singly or made up into a compost with 40 cart-loads of peat-moss, and has thus been found peculiarly favourable to the growth of wheat and beans. In those parts of the coast of Cornwall where the pilchard fisheries occasion considerable quantities of salt to be condemned, it is also much used as a preparation for turnips in composts mixed up with sea-sand, and spoiled fish, dung, and rotten slaty earth, in various proportions, to which from 40 to 60 bushels of lime are commonly added. The quantity of this kind of compost commonly applied to an acre, is usually about a ton of the fish and salt,—more or less as the fish prevails, and in that country it has been long considered as a most valuable and lasting manure, though probably its effects may be at least equally due to the oil and refuse fish, as to the salt with which it is combined†. It may also be advantageously mixed with stable-dung alone.

On *meadow ground*, Mr. Hollinshead advises the farmer 'to sow six bushels of salt per acre, immediately after the hay is got in; which will not only assist vegetation, and cover the face of the ground with grass, but will induce the cattle to eat up the eddish. For *pasture land*, he however recommends the application of foul salt at the rate of 16 bushels per acre; or, which he seems to prefer, to apply it in the same quantity, mixing with every 16 bushels of the salt 20 loads of earth, turning it two or three times, to incorporate it, and laying it on in the autumn.

In *frosty weather*, it has excited the surprise of many persons that, when the land was quite white through heavy hoar-frost, ground which had been top-dressed with salt remained perfectly green, and apparently free from its effects. It is, indeed, known to chemists to be an enemy to congelation; but we have, as yet, no practical knowledge of its effects, in that view, upon vegetation, nor are we aware that its application would tend to preserve crops from the consequences of frost.

The *quantity of pure salt* recommended to be applied to land as manure is from 4 to 16 bushels per acre, beyond which it has been generally found to become injurious to crops when sown with the seed; but, if laid in the autumn upon land intended for a clean summer fallow, from 30 to 40 bushels may be spread, according to the condition and nature of the soil. In the directions for its use given in the recent treatises of Mr. Cuthbert Johnson, from 5 to 20 bushels are assumed as the limits of its application to different crops; and although we think that, in most cases, the latter quantity would be found too large, and that, in all, the rules for its adoption savour somewhat too much of theory, yet as, with due discretion, in many instances they may serve as guides for its employment, we here transcribe them with very slight alteration: with this observation, that they only apply to the first year's manuring; though it has been stated by Mr. Hollinshead and others, that an annual application of a much less quantity will always keep the land in a state of the greatest fertility:—

For wheat and rye, 10 to 20 bushels per acre, put on after the seed has been harrowed in; the earlier the better, but may be done until March.

* Cheshire Report, p. 237.
† Sir H. Davy, Elem. of Agric. Chem., 4to., p. 296.

For barley, oats, peas, and beans, 5 to 16 bushels per acre. For these crops it has however been found beneficial, in the west of England, to lay it on after the seed has been harrowed in; but in counties less humid, it would be more advantageous to spread it in January or February.

For turnips, and most green crops, 5 to 15 bushels per acre, put on about a month before seed-time; or in January or February, as the salt will then meet the insects in their weakest state. Mr. G. Sinclair, however, says—that, for the destruction of slugs, salt should be used in not less quantities than 10 or 15 bushels per acre, applied to the surface of the land.

For potatoes, 10 to 20 bushels per acre in January or February, if no other manure be used; but if a light dressing of dung be intended at the time of planting, then half the salt to be spread after the plants have been covered in.

For hops, 15 to 20 bushels per acre, in November or December.

For grass-land, 10 to 15 bushels per acre in the autumn, and, if possible, not later than November; but may be put on, without injury, until February. If applied to the extent of 40 to 50 bushels, the old turf will be completely destroyed, but has been generally succeeded by a new sward of sweeter herbage.

In Dacre's 'Testimonies,' which contain a voluminous mass of facts adduced in favour of the use of salt for agricultural purposes, it is said, that although the fertilizing qualities of salt, when used by itself as a manure, are very great, it yet requires discretion to guard against putting on too much: a few bushels to an acre are sufficient. If any large quantity be put on, it will by its pungency and strength destroy vegetation for a time; but afterwards, when the salt has been well dissolved in the soil, the land becomes very rich. That when mixed with dung and other manure, it is highly efficacious: but the safest way of using it is, to sprinkle it occasionally over the dung in the cattle-yards, that it may amalgamate with it, and ferment.

The effects, as ascertained by the result of its use upon the Continent, are described by that eminent agriculturist, Von Thaër, to be nearly similar to those we have stated. When applied in large quantities, vegetation seems completely stopped; but when the salt has been washed in by the rain, and partly decomposed by the mould, it adds to its force during several following years. On rich land, when spread in small quantities, it produces very sensibly favourable effects, though of short duration; but if laid upon a poor soil, in an equal quantity, it has been found wholly ineffectual *.

NITRE,

Or *saltpetre*, as it is more commonly called, though of more powerful effect than common salt, is yet so rarely employed as manure, and must necessarily be so limited in its use for that purpose by the scantiness of the supply, that we should hardly have adverted to it, except as matter of secondary interest to a few speculative farmers, had not our attention been called to it by some papers which lately appeared in the 'Quarterly Journal of Agriculture' †. From these we learn, that it has for some years past been used in parts of Hertfordshire, and appears to be rather on the increase; that good crops have been produced by it, where crops never were good before; that it has been chiefly applied to wheat, barley, oats, and grass

* Principes Raisonnés d'Agriculture, 2nde éd., tome ii. p. 432.

† New Series, Nos. ii. p. 208, and iii. p. 302.

in the early part of spring, sown over the crops in the proportion of 1 to 1½ cwt. per acre; and that the common price is about 25s. per cwt.

As to the soil which is the most benefited by its application, there is, as usual, much disagreement; but it is generally regarded as favourable to chalky land, and the accounts all concur in representing its effects upon grasses in general, but particularly on clover, as being very striking. It is also generally said to succeed best if sown in damp weather; that it should be pounded till it will run through a wheat-sieve, and may be sown by itself, but it is not uncommonly mixed up with ashes. It is, however, of various qualities, which differ exceedingly in strength, and make a proportionate difference in its effects upon the land, by inattention to which errors may be occasioned in its application. From its analysis, as made by Sir H. Davy, it appears that wheat contains more nitre than any other product of a farm, and it was therefore expected to be peculiarly favourable to the growth of that grain *: the fact, however, seems at variance with this theory; for, although it has generally occasioned an increase of straw, the yield of grain has not been improved, and the crops have, in many instances, been found unusually subject to mildew.

EXPERIMENTS ON NITRE.

The following are extracts from a few of the trials which have been recorded on soils :—

> Upon *heavy clay* nitre has been used during twelve years, at the rate of about 1 cwt. per acre, and has exceeded the effects of both rock-salt and soot. When tried upon turnips, they failed; probably as the soil did not suit them; but the land being afterwards sown with wheat and barley, both crops were the best ever produced upon the farm; and upon grass, there never was before anything like the bulk upon the same land.
>
> Upon *clay and gravel*, it produced more straw than when the land had been dressed with soot; but not the same yield of corn.
>
> Upon a *strong loam* it was applied to wheat, after a crop of potatoes; and to grass, intended for hay. Upon both, the effect was wonderful: the hay where the saltpetre has been laid is a full third stronger, and was at least ten days earlier; the wheat so much too strong, that it will probably suffer in consequence.
>
> Upon a *gravelly soil*, when applied at the rate of 1½ or 2 cwt. per acre, it has been found to produce a vast bulk of straw, which occasions it to mildew; and for wheat, soot has been found preferable. When the barley crop has been dressed with saltpetre, the clover after it has succeeded particularly well: 2 cwt. per acre have also produced a monstrous crop of tares; but, in another account of experiments, it is said, 'That in nine years nitre was never known to fail, except on tares!'
>
> Upon *chalks*, it is generally admitted to improve the produce of all crops, and particularly oats. When tried with barley against hen-dung, the saltpetre produced the largest bulk, but the hen-dung gave the largest yield; and other accounts do not speak favourably of its application to barley.
>
> Upon *cool and wet soils*, and in *humid seasons*, it has been found

* It is known by chemists as *nitrate of potass*; and, according to this analysis, consists of one proportion of azote, six of oxygen, and one of potassium. Sir Humphry Davy says, that it may possibly furnish azote to form albumen or gluten, in those plants that contain it.

during five or six years to suit wheat and oats. On *dry soils and seasons* it has been said 'to do no good, but rather harm;' while another account says, generally, 'that it does best in dry seasons.'

Upon crops of wheat and oats, as well as upon grass, it is stated by Mr. Bruce, of Kennet, to have been applied at the rate of 1 cwt. per acre; the only variation in the experiments being in the time of its application *.

Upon *wheat*, after summer fallow with lime, but without dung of any kind, it was applied in two separate portions on the 28th of March and the 14th of April, when the land, which is a strong clay, was very wet. In about four weeks afterwards the difference was very apparent, both in the colour being darker, and the blade broader: when in ear, the straw was about five or six inches taller, and when reaped there was more bulk; but the crop was so injured by heavy rain at harvest, that no comparative estimate could be formed regarding either the quantity or the quality.

Upon *oats*, the same effect was apparent, but the consequences of the weather were also similar, and therefore prevented any calculation upon the crop. But it appeared that less than 1 cwt. might be used with advantage; and that it ought to be applied when the land is moist.

Upon *grass*, two portions of a field of strong clay, sown with pasture grasses, the saltpetre was applied on the 28th of March, 1829. In about eight or ten days afterwards, the ridges which had been spread with it were quite different from the others: the colour was a darker green, and vegetation not only commenced before the remainder of the field, but there was a full bite before the rest of the ground could be pastured. The grass was also sweet and luxuriant, for the cattle appeared to prefer the saltpetred ridges, and kept them bare of grass.

Upon *hay*, in two fields—one of coarse land and the other dry ground—the difference was the same in both; it was cut sixteen days before the remainder was ready; and when made into hay, there was also more bulk.

APPLICATION.

In answer to some information requested of Lord Dacre, who has applied it to his land, his Lordship says, that he considers it may be advantageously used as a top-dressing to present crops, in March or April, at the rate of 1½ cwt. per acre; but that it appears to be most profitable to Lent corn and grasses,—both permanent and artificial. Its effect upon meadow land is great; but, inasmuch as it presses upon the stronger grasses, it may, and probably does, smother the dwarf herbage. His Lordship doubts its having strength to bring wheat to full maturity, though its effect upon the straw is immediate and great. No mildew has attended it; but it produces a rank and dark appearance in the stalk.

Mr. Curling, of Offley Holes, says it succeeds equally well on all soils, on any sort of corn, or natural or artificial grasses; that it causes an equal increase of both straw and grain, and is far superior to any other light manure. He has not, however, observed any effect on the succeeding crop; in which he is corroborated by other accounts. Generally, it has been found most beneficial to grass-land; it is destructive to wire-worms†, slugs,

* Prize Essays of the Highland Society, N. S., vol. ii. p. 197.

† Of this there is a remarkable instance mentioned by Mr. Crabb, of Temple Dinsley, on whose land a field of barley was much infested with the wire-worm, but on top-dressing it with saltpetre, in the month of May, they all died after the first shower of rain.

and other insects, and it is recommended to be sown after the crop is well up, intimately and carefully mixed with ashes, at the rate of 1½ cwt. to a small cart-load, for one acre of land.

Regarding the quality, it seems the goodness is measured by the angle at which light is refracted in passing through it; an angle of 5° is called par, and the variations in value are made diminishing or increasing—not the price, but the quantity; for as the quality is better as the angle is less, an allowance in weight is made accordingly. The inferior sort contains common salt. It is tested at Apothecaries' Hall, and the quality marked upon the bags, so that any one who takes the trouble of attending the quarterly sales of the East India Company can at once ascertain its value; but deceptions are constantly practised by the dealers, and as the trade will, perhaps at least at the outset, be less carefully regulated under the new system than formerly, it is not improbable that these frauds will be increased.

Chapter XIX.

MISCELLANEOUS MANURES—(*continued.*)—BONES.

Bones, although of comparatively late introduction as manure, have yet occupied so much of farming attention within these few years, that we have no hesitation in placing them at the head of those miscellaneous substances which are usually employed for that purpose. They have indeed been used in some parts of England for a long time, and have been extensively imported from the Continent into the town of Hull, where several machines have been erected either for grinding them into powder, or bruising them into small pieces; which modes of application have been found so advantageous, that they have, within the last twenty years, excited general attention, and are now in almost universal use as the principal manure for raising turnip crops on the calcareous soils in Yorkshire and Lincolnshire. It is upon this description of land that they are the most decidedly valuable, and the testimony of some farmers of experience proves that to mix them with a portion of vegetable or coal ashes is a profitable application for the production of turnips; as, by this method, the vegetation of the seed is quickened, and the young plant, getting rapidly into rough leaf, thus escapes the fly*.

Long before the great advantage which may be derived from ground or well-crushed bones was generally known, many persons were aware of their fertilizing properties. To render them available, however, the wasteful and injurious process of reducing them into ashes by fire was then commonly resorted to; by which, indeed, a certain degree of benefit was imparted to land upon which sulphate of lime or gypsum will have effect, but could not be so effectual, in point of nourishment, as bone in an uncalcined state, because the oil and other nutritive matter which it contains is thus dissipated. In other instances, they were either reduced by lime, or laid at the bottom of the farm-yard, and decomposed by the effect of urine, and in some cases were partially broken by the hammer. In these modes, however, great quantities were wasted, which is now prevented by the improved method of preparing them by machinery: it is therefore useless to enter further into the details of practice which has become obsolete.

* See the section on Composts, p. 403.

When reduced to powder, the bones alone are ground, being divested by the process of boiling, not only of every particle of flesh, but also of a material portion of oil which is also extracted; and it is only in that state that they can be brought to the condition of fine powder. In this state it is only reasonable to suppose that they cannot be so beneficial to the land as when fresh and unboiled; yet we find, by the report of the Doncaster Association "on bone manure,"—to which we shall presently refer,—that they have been found more effectual after having passed through the manufactories. When not ground completely into powder, they are, however, broken in the machines, by cast-iron rollers, formed with deeply indented rims, by which they are first partially bruised, and then falling down upon other sets of rollers, each with the teeth more closely fixed, they are in this manner reduced to various sizes, from one inch to half an inch in thickness, and a considerable quantity of coarse dust is also procured by the process. These bones are usually sold under the respective designations of inch, three-quarters inch, half-inch, or dust; but the greatest demand is for those of the half-inch size, which contain all the dust which has been formed in crushing them. The "dust" is collected in great measure by riddling the inch and three-quarters inch bones.

When the bones are not boiled, each pair of rollers is furnished with a set of malleable iron scrapers attached below, in order to clear the teeth of any animal matter which may adhere to them, and thus the oily substance contained in the bones is saved*. As bone-mills have been now very generally erected, there are few parts of the country where the manure cannot be procured in a prepared state; but when the bones are only to be had raw, and it is an object with the farmer to reduce them to a small size, they can be easily broken to pieces by his own labourers. Several farmers have indeed erected small machines with two cylinders of cast-iron, with teeth, which lock into each other, by which they are broken into small pieces. The price at the mills varies, of course, according to the trouble of preparation, the distance of carriage, for grinding, and the demand; but commonly averages, for the dust, from 2*s.* 6*d.* to 3*s.*, and in some late instances even 3*s.* 6*d.* have been paid—for pieces, from 2*s.* to 2*s.* 3*d.*, according to size,—and 1*s.* 10*d.* for rough bones, per imperial bushel. No allowance appears to be generally made by the dealers on those which have gone through the process of boiling.

The expense of bones purchased in the rough state, and broken on the farm, is thus stated as an actual charge incurred per acre—

24 cwt. bones, prime cost	£2	3	2
Carriage of ditto, 7 miles	0	7	0
6½ days, man breaking bones, at 1*s.* 10*d.*	0	11	11
3¼ ditto, a girl spreading ditto on the drills	0	2	11
	£3	5	0

EXPERIMENTS.

Their effects will be best seen by the following trials:—

On the estate of Garrowby, on the Yorkshire Wolds, belonging to Sir Francis Wood, the crops of turnips had dwindled to nothing, and the fallows, though tolerably manured, were covered only with

* See the Prize Essays of the Highland Society, for a detailed description, accompanied with plates of a very complete mill for crushing bones, erected by Mr. Anderson of Dundee.—N. S., vol. i. p. 301. Ibid. p. 73.

common hemp, nettle, and other weeds, instead of turnip plants; but by the use of twelve to twenty bushels of bone-dust in drills, the turnip crops have become excellent, and the following crops are very considerably improved*.

At Clumber Park, the seat of the Duke of Newcastle, in Nottinghamshire, 600 bushels of small bones were, in 1822, spread upon 24 acres of grass land, in the dairy farm, consisting of dry, sandy, and gravelly soil, which had been laid down about ten years. Their effect upon the pasture improved the condition of the cows so materially, that about twice the quantity of butter was made from them than from cows grazed upon land of similar quality, but not boned; and this effect, it is said, still continues†.

Twenty-five bushels of bruised bones, per Scotch acre, having been applied by Mr. Watson, of Keillor, near Cupar Angus, to Aberdeen yellow turnips, on some sharp black land, brought them above ground on the third day, and into rough leaf on the tenth; on the fifteenth they were fit to be thinned out; while farm-yard manure, though applied to the same soil, at the rate of twenty-five cart-loads per acre, did not bring them up till the fifth day, nor render them fit for the hoe until the twentieth. They in this manner manifested the same superiority until the month of September, when the weather having set in dry, it was expected that the crop would cease growing; which was the case with that part which had been dunged, but the bone turnips continued to grow vigorously, and upon a comparative trial in the middle of October, their produce exceeded those which were dunged by six tons per acre: twenty-eight tons to twenty-two‡.

On some land, the quality of which is not stated, crushed bones were laid by Mr. Falla, of Gateshead, near Newcastle-upon-Tyne, at the rate of 100 bushels per acre; the rest of the field being manured with well-rotted stable-dung, at the rate of fifteen two-horse cart-loads per acre; that part which was boned was superior to some parts of the dunged ground, and fully equal to the rest§.

Mr. Graburn, of Barton, in Lincolnshire, has manured with crushed bones, at the rate of thirty bushels, and with dung at eight loads per acre, for turnips, after which the turnips were much later than the rest. On the second year of seeds, after the turnips, he covered the dunged part with yard manure a second time, and two years afterwards a third time; then sowed the land with wheat, and the boned ground produced rather a better crop than that which had been thus thrice dunged‖

During the dry summer of 1826, thirty-four acres of a siliceous sandy soil, on the estate of Sir Charles Throckmorton, at Buckland, in Oxfordshire, half of which had been manured with farm-yard manure, and the remainder with bones. The whole was sown with turnips, drilled in the Northumberland fashion; and that portion on which the bones were laid presented a remarkably fine crop, nearly a fourth part advanced in bulb about the latter end of August, while that part which had been dunged was merely getting into leaf. The experiment was repeated in 1827, on green-globe turnip, sown on the 20th of July, upon similar land, with the same superiority in

* Doncaster Report, p. 6. † Ibid. p. 13.
‡ Quart. Journ. of Agric. N. S., vol. i. p. 41.
§ Farmer's Magazine, vol. xvi. p. 380. ‖ Lincoln. Report, p. 300.

favour of the bones: the succeeding crop of barley also produced five bushels per acre more than that which followed the dunged turnips, and the clover was also heavier*.

The Honourable Captain W. Ogilvie, of Airlie Castle, has also applied bone-dust, at the rate of 15 and 20 bushels per acre, to a light sandy loam, with a subsoil of gravel and sand, coming in some places nearly to the surface; and after the experience of five years upon a series of trials commenced in 1827, he found all the successive crops of turnips, barley, and grass-seeds so decidedly superior to those which had been previously produced by other manure, that the Highland Society last year awarded their honorary silver medal to his Report.

To these facts in favour of bone manure, others must, however, be also stated of an opposite tendency, particularly when placed in opposition to farm-yard manure, to which we wish to call especial attention in comparison with bones, as being at the command of every farmer.

On the estate of Mr. Evans, jun., of Dean House, also in the county of Oxford, bones were tried for the wheat crop upon calcareous stony land, in comparison with stable-yard manure; but the dung had so greatly the advantage, that the bone crop appeared but little if any degree better than that on soil without any manure whatever†.

On the lands of Mr. Hawden, in Kincardineshire, turnips were sown in the month of June, on various soils, in drills laid off at 27 inches apart: the manure was laid on in single Scotch acres; and the produce of the roots, exclusive of tops, accurately weighed, as follows:—

On a mixture of stiff clay and gravel,

12 tons of farm-yard manure	produced	26 tons	8 cwt.
1½ ,, bone-dust	,,	23 ,,	12 ,,

On a soft sandy soil, naturally inclined to moor,

16 tons of farm-yard manure	produced	29 tons	12 cwt.
1¼ ,, bone-dust	,,	24 ,,	16 ,,

On a sandy light soil, sown the following year,

16 tons of farm-yard manure	produced	25 tons	16 cwt.
1 ,, bone-dust	,,	23 ,,	18 ,,
10 cwt. horn-shavings, mixed with 1 cart-load of hen-dung and 9 ditto coal-ashes - - -	,,	20 ,,	6 ,,

It is also remarkable, that although three of the drills were spread unmixed with the horn-shavings, which are considered as a more powerful manure than bone, yet they only produced at the rate of 2 tons 13 cwt. per acre‡.

On Mr. Boswell's farm, of Kingcaussie, in Kincardineshire, two acres of Norfolk globe turnips were drilled upon poor high ground, reclaimed from moor, and

20 cart-loads, or tons, of dung	produced	32 tons	14 cwt.
1½ ton of bones	,,	28 ,,	13 ,,

On the same farm, in another year, the season of 1824 being cold

* Prize Essays of the Highland Society, N S., vol i. p. 75, communicated by Mr. G. Sinclair.

† Ibid. p. 77, communicated by Mr. G. Sinclair.

‡ Prize Essays of the Highland Society, N. S., vol. i. p. 69.

and wet operated very much against the turnips which were manured with bones; but in that of 1822, those raised with bones and stable-dung appeared to be equal*.

Notwithstanding this evident difference against the produce obtained by bones, in point of weight, it should not, however, escape remark, that the latter gentleman estimates the value of their return in money as being superior; for the cost of the two manures is, according to his calculation, as follows:—

One acre manured with farm-yard dung—

20 cart-loads of dung, including carriage, at 10*s.* per load	£10 0
33 tons of turnips, at 10*s.* per ton - -	16 10
Net return -	£6 10

One acre manured with bone—

1¼ ton of bones, at 42*s.* -	£2 12 6	
Breaking and driving ditto	0 18 0	
		3 10 6
29 tons of turnips, at 10*s.* per ton -		14 10 0
Net return -		£10 19 6

Thus leaving a difference in favour of bones of no less than 4*l.* 9*s.* 6*d.*,—or what we should in this country call a tolerably fair value, if fed off, for the produce of an imperial acre: but although the price of the turnips is far beyond present rates, and the charge of dung, unless carried to a great distance, is too high, we yet leave the account as it stands, as forming a ground for similar comparative calculations.

To this may be added the following particulars of a comparative trial between stable-manure and crushed bones, lately made on the property of Sir William Maxwell, of Calderwood. The field was an old ley, consisting of a strong loam, on a retentive clay bottom; but having been completely drained, as well as ploughed and cleared, under favourable circumstances, the condition of the land—from which a previous crop of oats had been taken in 1832—was perfectly satisfactory at the time of preparing it for turnips, with various species of which it was sown in the following spring; and in addition to the quantities of manure stated at foot, 7½ chaldrons of lime were laid per Scotch acre. Where stable-manure had been applied, the plants sprouted more rapidly and vigorously than was the case with the bones; but ultimately the latter gained ground, and, if any thing, got rather the start of the dung, and no part of the crop suffered in any degree from the fly. The most accurate calculations were made in order to ascertain the produce of the crops per acre, and the following was the result:—

Swedish, .	30 cart-loads of stable-dung per Scotch acre, produced		29 tons.
	60 bushels of crushed bones	"	24
Dale's Hybrid	30 cart-loads of stable-dung	"	33
	60 bushels of crushed bones	"	31
	45 ditto	"	29
Yellow Bullock,	30 cart-loads of stable-dung	"	29
	60 bushels of crushed bones	"	28

The quality of the soil is, however, by no means particularly well adapted for the turnip culture, partaking, as it does, rather too much of the clayey character; and although it was divested by drainage of all superfluous moisture, yet there can be little doubt that to that cause the comparatively unfavourable effect of the bones may be chiefly attributed †.

* Prize Essays of the Highland Society, N. S., vol. i. p. 74.
† Quart. Jour. of Agric., N. S., vol. iv. p. 836.

EFFECTS OF BONE-DUST AND BONES.

Bone-dust is the fittest state in which to lay it upon grass, for it will not only take more immediate effect upon the crop, but if laid in pieces, it would interrupt the progress of the scythe. It should, however, be recollected, that fine powder can only be obtained from spent bone which has undergone the process of manufacture. It is therefore spread, as a top-dressing, by hand; but it is also very commonly laid in the drills for turnips, for which purpose many ingenious machines have been contrived for sowing it along with the seed *. It is, however, much to be regretted that these implements cannot be constructed with more simplicity, for their cost is so considerable, that unless a man has a very large quantity of land to drill, their purchase would be imprudent, and the hire is generally unreasonably expensive.

Regarding the *quantity of dust*, the powdered bones are dearer than those which are merely broken small, and although said to be more forcing to the first crop, on account of their being, when in the state of powder, more intimately blended with the soil, and more directly applied to the seed, yet they are not found so durable as when they are laid on in pieces; but it is also true that, in the former case, they are not laid on so largely, for the amount depends entirely on the size of the bones. They have been applied, in the rough state, to the extent of 100 bushels per acre; but the average quantity, of all sizes, is stated, in the Doncaster Report, to be 39 bushels. When the smaller bones are distinguished from the larger, they, however, seldom appear to exceed 30 bushels per acre, and in many cases do not arrive at 20: perhaps it may be assumed, as the most general practice, that half-inch bones are employed at the rate of 25 to 30, and dust at 20 bushels per acre; but a distinction should be also drawn between the quantity of those which are applied after being manufactured, and those which are laid on in a raw state.

The *size of the pieces to which the bones should be broken* is also an object of some importance, as the smaller they are the more prompt will be their effect: on which the following observation has been made by one of the correspondents of the Doncaster Association:—"That if he meant to till for early profit, and if he wished to keep his land in good heart, he would use half-inch bones; and, in breaking these, he should prefer some remaining considerably larger:" the reason assigned for which is,—"that by using bones of a large size, with dust in them, there must be sufficient of the small particles of the dust to set the turnip-crop forward, and sufficient of the large particles of the bone left to maintain the land in good condition for the last crop."

Respecting their durability, it has been affirmed, that the effect will not be increased if they be laid on to great amount; for the same produce has been obtained from the comparative application of 50 and 100 bushels; and an experiment has been tried by varying the quantity on different ridges of a large extent of ground under turnips, at the rate of 28, 40, and larger quantities alternately, without creating any visible difference in the crop †. This, however, may be perfectly correct, so far as regards one or

* A very detailed description of one of these instruments, along with an engraving, may be found in the Quarterly Journal of Agriculture, N. S. vol. ii. p. 719. Another machine for the same purpose, but with a double hopper, for sowing two drills at one time, is also described, together with a plate, in the Prize Essays of the Highland Society of Scotland: N. S., vol. ii. p. 206.

† Quart. Journal of Agric., N. S., vol. ii. p. 108.

two crops, for it has been found that, when used in large quantities, they have rendered the land extraordinarily productive during a great length of time, of which we find the following instances in the Doncaster Report:—

1. On a field, part of which was boned forty years ago, the crops were, on that part, during fifteen or sixteen succeeding years, visibly better than the remainder, although the land was all of the same quality, and the part not boned was manured with farm-yard dung.

2. In another case, about three acres of light sandy land were dressed, in 1814, with 150 bushels of bones per acre; since which time the land is said to have never forgotten it, but is nearly as good *again as the other part, farmed precisely in the same way, with the exception of the one application of bones* *.

We learn, also, from experiments at Kew, that although they yield a certain supply of nourishment to plants the moment they are capable of receiving it, yet that is done so gradually as to furnish only a regular and moderate supply: reasoning upon which, it is to be presumed, that as a large quantity does not produce the effect of forcing a crop in proportion to the amount supplied, neither can it be so soon exhausted by the gradual consumption of the smaller quantity. This application may therefore be perfectly consistent with good husbandry, if applied to any amount, however large; though, as regards the farmer's purse, the expenditure of the outlay is a different question. The extent of their fertilizing quality is greater upon grass-land, under cattle, than upon arable. Valuers estimate the allowance to a quitting tenant by supposing the effect of bones upon tillage and meadow-ground to be exhausted within four years; but on grass-land depastured it is considered to last during eight†.

Experience seems to be in favour of laying the manure in *drills*, especially when applied to turnips, although the superiority of the *broadcast practice* is maintained by some very intelligent farmers, who hold—that the turnip plant receives its support principally from the fibres which it throws out sideways, to a much greater length than people will believe, and derives more nourishment from them than the tap-root; and that the bones being dispersed, the fibres are more likely to meet with them than when they are accumulated round a tap-root, and that method must be the best which occasions the greater quantity of nourishment to be conveyed to the body of the turnip. In drilling the bones, there is also a difficulty found in the after-ploughing, of mixing them with the soil; and although this may be in some measure obviated by cross-ploughing the ridges, yet that portion of the land on which the manure is thus laid receives more than an equal degree of benefit. A third mode is however acted upon by others, who sow them broadcast, and gather them into ridges with a mould-plough.

The *time for laying them upon the land*, when applied to grass, whether natural or artificial, is generally recommended to be early in the spring;

* *About sixty years ago, a farmer is also said to have obtained a forty-years' lease* of a tract of poor land, in a high situation near Rochdale, in Lancashire, on which, after fencing and draining it, he erected a bone-mill, and began manuring the ground at the rate of 100 to 130 bushels of bones and dust per acre. The consequence of which was, that in a few years he let off more land than paid the rent of the whole, and retained a large farm in his own hand. The Correspondent of the Quarterly Journal of Agriculture, from whom these details are taken, says, "that one acre would summer a cow of large size, and that some fields were cropped with oats ten or fifteen years in succession; yet that it is surprising to see the herbage which the land still produces, both as to quantity and quality, near one-half being white and marl clover. —N. S., vol. iii. p. 715.

† Report of the Committee of the Doncaster Agricultural Association, on Bone-Manure, p. 14.

but if upon meadow, the growth of which has been fed off, then the moment the cattle are removed. Experience, however, varies upon this point; because it has been found to depend materially upon the season and the state of the land, which, if wet, will be more benefited by delaying the operation until the weather becomes warm and the ground dry.

When applied in the drills of arable land, they are of course deposited along with the seed; but when spread broadcast, then they are not uncommonly either harrowed in immediately previous to the sowing, or with the last ploughing; though, when used in a fresh state, without having been subjected to the process of manufacture, they should always be laid in sufficiently long before the sowing, to allow them time to ferment, or they will not take immediate effect upon the rising crop*.

The *soils to which they are best adapted* are those of a light and warm nature; for on wet and cold grounds they have rarely been found to produce any sensible benefit. Their power of contributing to lighten strong land, by their mechanical action upon the soil, and thus rendering it less adhesive, has indeed been vaunted, and, if laid on to a very large amount, there can be no doubt that the bones, in pieces, would have some such effect; but the smallness of the quantity in which they are usually applied renders their force for that purpose quite insignificant.

On *heavy loams and clays*, the accounts of their operation have been almost invariably unfavourable; and it may be laid down as a necessary qualification in a soil fit for the application of bones, that it should be dry. This, indeed, has been contradicted by experiments stated in the Doncaster Report, upon what is described as a wet sand soil, with an irony-coloured subsoil, upon which two quarters per acre were drilled, and produced an excellent crop, when manure had been previously tried without effect. This, however, having occurred in the years 1826 and 1827, which were unusually dry, may serve to explain the fact, without affecting the principle that bone manure is not generally beneficial to clay lands.

The same Report states, that "*upon very thin sandy land*, the value of bone-manure is not to be estimated; it is not only found to benefit the particular crop to which it is applied, but extends through the whole course of crops; and even in the succeeding courses, its effects are visible in the improved quality of the land, and the efficiency of a smaller quantity than would at first have insured a crop. Upon much of the high land about Babworth, which is a light sandy soil, the crops under ordinary farm management were comparatively unproductive; but since the introduction of bones, after having been dressed for several fallows with sixty or seventy bushels per acre, they have not only become productive, but so much improved in quality as to return an equal crop with a much lighter dressing of manure or bones throughout the next course."

"On the *dry limestones* near Doncaster, the same favourable results have been obtained; and no failures, beyond those attributable to peculiarity of season, are noticed."

On the *Wolds of Yorkshire and Lincolnshire*, it also appears, by the testimony of several extensive farmers, that "before bones were generally used with turnip-seed, many thousand acres were annually sown for that crop without any manure whatever, from the impossibility of getting fold-manure for more than one-third or fourth of their fallows. The turnips upon such unmanured land were consequently very indifferent; and the benefit of sheep feeding upon their tops—for of bottoms they seldom had

* Doncaster Report, p. 16.

any—was very trifling. Since the use of bones has, however, become general, the turnip crop has been, in many instances, ten-fold, and in few less than four or five-fold its former bulk. All the succeeding crops of grain and seeds have been amazingly increased, and, upon the four or five-shift system, there is no doubt the land will go on progressively improving, requiring a less quantity of bones annually, from its increased fertility and power."

On *light loams*, the returns to the Doncaster Committee give bones a preference to farm-yard dung. And we learn that, upon the calcareous soil of the Yorkshire Wolds, heavy crops of turnips have been raised from 16 bushels per acre of bones, while in the same field, and under similar circumstances, but manured from the farm-yard at the rate of from 8 to 10 tons per acre, the turnips have been of the most inferior description.

On *peat soils*, if previously drained and laid dry, their advantages are reported to be so striking, that from fifteen to twenty bushels of dust per acre, drilled, have been also found to very far surpass the ordinary dressing of stable-dung, and even of lime and pigeons'-dung.

On *gravels*, the reports are meagre and contradictory, though perhaps reconcilable in principle, as it has been justly observed, that "a gravelly soil may embrace every variety of texture and quality, from the light dry sand to the water-logged yellow clay—preserving in each the necessary admixture of stones and grit." To wet gravel, their application has been found decidedly unfavourable *.

ANALYSIS.

An examination of the component parts of soils, and of the power of bones, when applied to them as manure, would go far to explain the irregularity of their different effects upon various kinds of soil. Bone is known to consist of about equal parts of earthy and animal matter; the former chiefly composed of gypsum—which is of so indestructible a nature as to have been termed, by early chemists, the "earth of bones"—and a small portion of carbonate of lime; from which we may conclude that probably half the weight of bones is in the greater part consumed by plants as direct nourishment in their state of growth, and that the remainder is more gradually absorbed by the soil, as well also as by the plants; for lime, though in small amount, is always present, in greater or less quantity, in all vegetable substances.

"The quantity of earthy matter varies according to the age of the animal; and, in like manner, the quantity of animal matter varies also in proportion to the condition of the animal. In the best kinds of bones for manure, viz., those from fat young animals, perhaps the following proportions may give an approximation to the relative quantities of each in 100 parts:—

Earthy and saline matter	40	parts.
Cartilage and jelly	40	
Fatty matter	20	

The soft parts thus form, in the best bone, about sixty, and upon an average, perhaps, amount to fifty per cent., which are almost entirely constituted of the same elements of plants, and all of them, sooner or later, liable to be dissolved and absorbed by the roots. The cartilage, indeed, when the bones have been buried in a dry situation, is very indestructible; but when exposed to the action of air, water, soil, and vegetation, will probably pass into the state of jelly, and be dissolved, or otherwise decomposed,

* Doncaster Report, p 8.

probably at the time when the fatty matter—the decomposition of which begins almost immediately—shall have been nearly exhausted *."

This analysis has been taken from an anonymous essay "on the action of ground bones on plants and soils;" the author of which observes, that "although it be granted that the composition of bones is thus well calculated to afford nourishment to plants, it must be admitted that the amount of their action as a manure still remains in a great measure unexplained. The quantity allowed per acre is not usually more than 10 or 15 cwt., of which not more than a half is efficient as manure; and this is but a small fraction of the weight which we carry off the field in vegetable produce. In these circumstances, we must either leave the matter unresolved, or have recourse to hypothetical explanation, to be confirmed or disproved by future observation." We agree with him in preferring the latter alternative, as best calculated to lead to a discovery of the truth; and as an inquiry into the cause of the different results occasioned by the specific application of bones to every species of soil would only lead us into a wide and probably fruitless discussion, we shall confine ourselves to an account of the analysis given by Mr. G. Sinclair, of the two kinds on which trials are mentioned by him to have been made in Oxfordshire.

That on the land of Sir Charles Throckmorton, on which the bone manure had such beneficial effects, contained in 400 parts:—

Fine siliceous sand, 167 parts; calcareous sand, 43; water of absorption, 99	309
Decomposing animal and vegetable matter, destructible by fire	24
Carbonate of lime (impalpable)	25
Silicia, or the pure earth of flints	23
Alumina, or the pure matter of clay	9
Oxide of iron	3
Soluble animal and vegetable matter, principally vegetable extract, with indications of muriate of soda	5
Moisture and loss	2
	400

That on the land of Mr. Evans, jun., on which the bone manure appeared to have no beneficial effect, consisted of:—

Calcareous sand and gravel, nearly pure carbonate of lime	217
Decomposing animal and vegetable matters, destructible by fire	17
Carbonate of lime (impalpable)	39
Silicia	85
Alumina	20
Oxide of iron	5
Soluble matter, principally vegetable extract, with sulphate of lime, or gypsum	4
Moisture, or loss	13
	400

On which he remarks, that "the striking and essential point of difference between these two soils consists in the carbonate of lime. In the soil so much benefited by the bone manure, carbonate of lime is deficient, while in the soil so little benefited by it, the carbonate of lime is almost in excess; at least, had it not been so much in the form of gravel and sand, the soil would have been what is termed cold. The differences, also, between these two soils, in the coarseness and fineness of their sand and gravel, and in the superior quantity of alumina, or clay, in calcareous soil, should not be overlooked."

The quantity applied to the siliceous sandy soil, where the bones had such

* Quart. Journ. of Agric., N. S., vol. i. p. 49.

beneficial effects, was 86 bushels per acre, partly supplied from the dog-kennel, and partly purchased. On the calcareous soils, they were applied in a larger quantity, and also in a recent state; on which Mr. S. observes, that "animal matter being so much more easily decomposed than vegetable matter, the recent bones must afford nutriment to the soil very speedily;" yet he adds, "that he has always found that both animal and vegetable matter, before they become beneficial to an immediate crop, require a first stage of decomposition, and that this degree of fermentation, or decomposition, is best effected before these substances are applied to the land."

This accords with the report of the Doncaster Association, in which it is said "to be acknowledged by their correspondents to be a prevalent opinion among intelligent farmers, that manufactured bones are equal in their effect to raw bones;" in proof of which they instance the following experiments:—

> Twenty-four acres having been boned at the rate of 50 bushels per acre, part with bones which had the oil stewed out of them, another part with bones which were full of marrow, and a third part with horses' bones having much flesh upon them. The crop, which was turnips, was all good, but the next crop, where the fleshy bones were laid, was not so good.
>
> Broken bones fresh from the dog-kennels were spread on a newly-ploughed clover ley of high sand land, at the rate of 80 bushels per acre, and on the following day sown and harrowed in with wheat; but the crop was bad, and no advantage was observed to be derived from the bones in the succeeding crops. The same experiment was repeated upon a piece of fallow in Blyth Forest, sown with turnips, with similar results; but the same gentleman having sent bones from the dog-kennels to be broken, and then laid upon a heap, and covered with earth, in which state they remained for about a month, after which they were laid upon turnips: their good effects were visible on every yard on which they were spread, being the largest and the best turnips in the field, although the other part was manured from the farm-yard, where a considerable quantity of oil-cake had been consumed.

These experiments certainly tend to confirm the fact, that fermentation is requisite to give immediate effect to bones as manure, which is only in accordance with the chemical principles applicable to all animal substances; for we all know, that although flesh, if buried in the earth, will not produce any benefit to the land until it is decomposed, yet that object once attained, its fertilizing powers are instantly brought into force; but we cannot admit that this warrants the conclusion, "that manufactured bones are equal in their effect to raw bones." They may indeed be superior on a first application; and we make no doubt that when thrown together and rendered putrid, they will become more promptly available than if they had undergone no fermentation whatever. Yet we feel persuaded, both from the nature of animal matter as manure, as well as from much inquiry regarding the practical application of bones, that when deprived by manufacture of the gelatin and oil which they contain, their improvement of the land will not be so durable as when they are laid on raw, or after fermentation when collected in a fresh state*. Many farmers are thus imposed

* Besides the various modes already in use of drawing oil and spirit from bones and horn, the cotton manufacturers in Lancashire are said to have lately used a glutinous substance, extracted from bones, in the fabrication of the weft of their low-priced cloth; and there are now a number of manufacturers of this newly-discovered matter.

upon by dealers; but the bones are sold to those who are aware of their real value, for much less than the price of those from which the oily sub stance has been extracted.

* COMPOSTS.

The fermentation of bone naturally leads to the consideration of the subject of forming *a compost of bones with earth and other substances*, by a mixture with which they soon become decayed and pulverized—a practice which is stated in the Doncaster report to have been recommended by several very intelligent farmers, thirteen of whom, solely from the result of their own experience, describe its effects as superior to those of bones used singly. With some of these, it is the practice to mix 50 bushels of bones with 5 loads of burnt clay, or good earth, per acre; by which dressing, the crops between fallow and fallow, excepting clover, appear to have been increased one fifth in value. Others use forty bushels of bones, broken from two to three inches, in a compost with five loads of farm-yard manure, and a sufficient quantity of earth, the effect of which has been felt on the wheat crop at the end of the four-course system. Many also mix up dung, soot, rape-dust, and the ashes from weeds and house fires, with the bones, by which great heat, and consequent fermentation, is occasioned.

The most general practice, however, is to form the compost entirely of bones and yard muck, mixed, in various proportions, with

From 50 bushels of bones	to	4 or 5 of dung.	
20	do.	4	do.
12	do.	8	do.

This, if the heap be well covered, will no doubt decompose the bones very rapidly; and one person states, "that he has used as much as 35 bushels of bone dust, per acre, without manure, in the same field where he laid six loads of fold manure, and ten bushels of bone dust; but the turnips on the part manured with bone dust alone were not so good as those on the part manured with the compost and the succeeding crops were still worse in comparison."

As the great amount of bones now actually consumed as manure, besides the quantities applied to other purposes, may reasonably excite an apprehension that the still increasing demand will soon exceed the supply and con sequently raise the price, a correspondent of the "Quarterly Journal of Agriculture *," has suggested the following economical method of employing them, which he has used for the last two years, and by which he states that he has obtained heavy crops of turnips.

He forms a compost, as the manure for one imperial acre, of 8 bushels of coarse bone-dust, with not less than double that quantity of coal-ashes which may be generally procured for about 5*s.* per ton. The ashes should be carefully collected in dry weather and placed under cover, in order that they may be kept free of moisture; or, if that be difficult, they may be strewed with a dusting of quick-lime: after which they are to be riddled as small as the dust itself, for otherwise, if sown with a drilling-machine, they will not pass easily through the hopper. The bones are then mixed with the ashes; the mass ferments, and evolves a considerable degree of heat, when they soon become fit for use.

Turnips raised with this compost, he affirms to have always possessed the same characters of a close crop, firm root, and hardiness to resist the rigours of winter, that turnips raised with bone-dust alone evince; in proof of which, he has sold them for 7*l.* per acre, to be eaten off by sheep. He,

however, supposes that it is the bone-dust alone which secures to the crop whatever nourishment may be imparted to it at the future stages of its growth, in which he is doubtless correct; but in imagining that he has thus discovered a more economical mode of their application in their effect upon succeeding crops, we imagine that his further experience will show him that he has been deceived; for although the fermentation of the bones, occasioned by the application of the ashes, may increase their power upon the actual crop, it will be proportionably diminished in those which follow, and we think that the instances which we have already stated must convince practical men that the durability of their influence upon the soil depends on the quantity in which they are applied.

APPLICATION.

Independently of the decided fertilizing properties of bones, when applied to dry and light soils, they have the great advantage of being procurable at a small expense of carriage, which diminishes the labour of teams to a great extent; for one waggon-load of 100 bushels, broken small, will in most cases be found equal to 40 cart-loads of yard manure. They are also capable of being preserved during a long time, when kept dry, without incurring damage, and thus may be stored up during the winter season, when farm business is not pressing; added to which, they leave the land freer from weeds than when it is manured with dung. This, and their suitableness to the drill husbandry, renders them peculiarly adapted to the cultivation of turnips—to which, indeed, they have been the most universally applied; and we need not remind our readers, that on the success of that crop generally depends those of the whole succeeding course. The instances are also numerous, upon all soils, of turnips being destroyed by the fly when sown in drills, having had the manure placed directly under them; when turnips sown in the same field, and on the same day, with bone-dust, have entirely escaped their ravages. Their value to the holders of light soils, in thus enabling them to procure the certain means of improving the returns from their land, by this increase of their quantity of nutritive manure, may therefore be considered inappreciable. It has been stated as the comparative result of some experiments, that bone-dust acts in the cultivation of grain, as compared to the best stable manure, in the following proportions:—namely,

In respect to the quality of the corn, as . .	7 to 5.
In respect to the quantity, as . . .	5 to 4.
In respect to the durability of its effects on the soil, as	3 to 2.*

We cannot indeed agree altogether in this estimate of its powers, but it requires no further arguments to press its application upon the attention of every farmer, who is in possession of ground to which it is suitable. We shall, therefore, only add the following summary of the rules for its application, as recommended by the members of the Doncaster Agricultural Association, from which it appears—

That on dry sands, limestone, chalk, light loams, and peat, bones are a very highly valuable manure.

That they may be applied to grass with great good effect.

That on arable lands, they may be laid on fallow for turnips, or used for any of the subsequent crops.

That the best method of using them, when broad-cast, is previously to mix them up in a compost with earth, dung, or other manures, and let them lie to ferment

* Repertory of Inventions, No. 86.

That if used alone, they may either be drilled with the seed, or sown broadcast.

That bones which have undergone the process of fermentation are decidedly superior (in their immediate effects) to those which have not done so.

That the quantity should be about 20 bushels of dust, or 40 bushels of large, increasing the quantity if the land be impoverished: and also, according to our opinion, if the bones have been already manufactured.

That upon clays and heavy loams, it does not yet appear that bones will answer.

On this latter observation, however, a farmer near Nantwich, in Cheshire, remarks, that he "occupies a farm in the township of Pickmore, the soil of which is a clay loam, scarcely twelve inches deep, the sub-soil a grey sand, mixed with coarse clay—which the farmers call *rammel*—on a bed of good clay marl. Two years ago, he covered the field with bone-manure; previous to which the grass was so sour, as not to be worth ten shillings per acre; but it is now full of most excellent herbage, consisting of white clover and trefoil;" to which he adds, that "in another of his fields, with a clay soil, a small portion of it was manured, thirty-two years ago, by a former tenant, with bones; and that, although it has been twenty years in tillage, yet that part still shows a superiority over the rest."*

Chapter XX.

MISCELLANEOUS MANURES (*continued*).—GREEN CROPS.

GREEN MANURES

Consist in full crops of succulent plants,—such as buck wheat, rape, tares, and many others,—which are ploughed into the land, and have been applied in many instances with very singular advantage, more especially on calcareous, gravelly, and sandy soils, the fertility of which has been thus greatly improved. The practice dates as far back as the time of the ancient Romans, and is still continued throughout Italy, even in places where the dung of animals can be procured in abundance. The climate of that country is, however, more favourable than ours to the system, for the corn harvests are so much earlier, that they are off the ground in time for succeeding green crops to arrive at full maturity; and it is there thought that nothing tends more to the improvement of the land than ploughing them down†. It has indeed been held by many intelligent men who support an opposite opinion, that the land which produces these crops will be deprived of their vegetative properties in proportion to their luxuriancy; and, therefore, that, by returning the crop into the same land, its fertility can only be increased in the same degree as it was reduced by their reduction. This

* New Farmer's Magazine, No. 82, December, 1833.

† In Tuscany, the plant which is chiefly sown for this purpose is the white lupin, a leguminous annual plant well known in our gardens, which grows in sandy and loamy soil, to the height of two or three feet, with a stem of equal strength with the bean, and bearing somewhat similar blossoms and pods; but the produce is so bitter that it is unfit for the nourishment of either man or beast, until prepared by some manufacturing process. It arrives to a considerable size in the month of October, when it is ploughed into the soil; and very extraordinary fertilizing properties are attributed to its effects, which are ascribed to the great quantity of gluten which it is known to contain. Whether it might be brought in this country to a sufficient degree of maturity for that purpose, as a field crop, we have no means of judging; but it may be worth the experiment.—*Simonde, Tableau de l'Agriculture Toscane*, p. 72.

theory, however, can only be supported upon the principle that plants are fed more by the soil than by the atmosphere; whereas it has been shown, by many curious experiments, that the air and water are the chief sources of vegetation; and it is a fact, that poor land, without manure, which by the fortuitous chances of the weather has produced tolerable green crops, has been found more fertile after their production than before.

When ploughed into the land, they however often remain for several months before they decay, for their decomposition goes on slowly beneath the soil, and they are therefore frequently more beneficial to the second than to the first crop. To turn them in effectually, they should be first heavily rolled, and then followed by a trench plough, for the operation cannot be completely performed with a common plough; and, if not entirely buried, their points stick out between the furrows, by which they are partly prevented from fermenting, and a portion of their value as manure is thereby lost.

The *time of the year* when they should be ploughed in, must, of course, depend upon the nature of the crop, which should always be buried before it arrives at perfect maturity, or otherwise it will rob the land of that nutriment with which it is intended to supply it. Most farmers take the first growth of tares and clover, which, if fed off early, is an economical plan; but if mowed, it is only doing the business by halves, for the land is thereby not only deprived of the dung of the cattle, but the operation is then too long delayed, for the work should be done in the heat of the summer, or, at the latest, early in the autumn, while the sun has the power to forward the fermentation. The effect, indeed, will greatly depend upon the season, for the process of fermentation is only slight when checked by the want of free communication with the air; and if the weather be cold, the power of the manure will be in a great measure lost; but if the season be moderately moist, and very warm, the fermentation will be much promoted, and the crop will be converted, by putrefaction, into a mass of nutritive mucilage. Nothing short, however, of an abundant crop will have that immediate effect, as a large mass decomposes much more speedily than a small one; and, if very scanty, the latter perhaps may not putrefy at all, or its decomposition will be so very gradual that the land will be very little perceptibly the better; but if such a quantity be turned under the earth as will excite the force of fermentation, there can be no doubt but that it will then be greatly as well as promptly benefited. Sir Humphry Davy, indeed, says, "that this gradual decomposition affords a supply of vegetable mould for several years*;" but although, as a chemist, he may be right, yet every practical farmer must know that, with such materials to work upon as cannot materially enrich the staple of the soil, his object should be to obtain such immediate effect as will enable him to put the land into a state for growing one good crop, which, by its means of producing manure, will probably lead to others. If the question whether it be most profitable to appropriate green crops as the food of cattle, or as manure, be put aside, and that the sole object is the improvement of the land by the latter process, then there can be little doubt that the crop should be ploughed down as soon as it is in bloom, for the land will thus have its full benefit, besides the partial advantage of a bastard fallow; to which, however, there is this difficulty opposed: that the ground cannot be again ploughed until it receives the seed furrow, and therefore cannot be cleared except by the operation of horse-hoeing, or scarifying, which, if the soil be foul, we need not say will prove ineffectual.

The crops which are most generally applied to this purpose are—buckwheat, winter tares, the second year of clover, and rape; which last, from its oily nature, has been found very effective. There is, however, a plant which, although but seldom sown in this country, is very commonly grown throughout Flanders, for the pasturage of cows, and is there sown, like brush-turnips, immediately after a crop of wheat, yet in a couple of months afterwards affords a large quantity of succulent food. Several trials of it have also been made with the happiest results in many parts of Germany, of its effects as a green manure; for it not only possesses the advantage of putrefying with great rapidity when ploughed in, but also that of producing a crop by being merely harrowed across the stubble, and the seed costs a mere trifle*: it is called *spurry* †. Out of a number of trials which have been recorded in this country, we select the following from the Essays of Mr. Burroughs on green crops and on manures:—

EXPERIMENTS.

1. A field of strong clay, containing three acres, on Mr. B.'s own farm, was laid out in the following manner. One acre was fallowed during the summer, and prepared for wheat with sixty barrels of lime, harrowed in; the adjoining acre was sown with winter tares, which were once cut, and the second growth turned into the land when the blossom appeared; the third acre was planted with potatoes, and manured with farm-yard dung. The entire of the field was sown with wheat the first week in November, at which time the acre sown with tares was much cleaner and in better health than those planted with potato or fallowed, and the following year produced more wheat, and of better quality, than either of the former. After the wheat crop was carried off, the field was immediately ploughed, and in the following May sown with barley and grass-seeds. The average of the corn off the three acres was nearly the same; but the meadow, the following year, produced more abundantly off that part of the field where the tares had grown, and the land was much freer from weeds‡.

2. After many ineffectual trials made by a very experienced farmer, in Herefordshire, to produce a crop of wheat off a field which had been several years in cultivation, he sowed winter tares as a fallow crop preparatory for wheat. The first growth of the tares was mown for soiling, and the second ploughed in for manure; yet, even under this management—of soiling, instead of feeding on the land, and of ploughing in the second, instead of the first, crop of tares§—the wheat afterwards produced was superior to any corn-crop he had ever obtained off the same field.

3. On part of a ley-field, in the county of Kilkenny, the tops of a crop of turnips on an adjoining close were cut off and spread upon the sward before it was ploughed up, after which the entire field was sown with oats; but the crop on that part of the field where the turnip-tops

* Annales de l'Agriculture de Basse-Saxe: 3me année, sect. 1re.

† See also Lord Dundonald's Treatise on Agricultural Chemistry, regarding the cultivation of *sorrel* in poor worn-out soils, for the purpose of a green manure; in which its application to the land along with lime is strongly recommended upon grounds which are well worthy of attention, but too long for insertion here.

‡ Essay, No. I. On the Cultivation of Green Crops, p. 29.

§ It is well known that unless tares are cut at a very early stage of their growth, there is no second crop.

The *quantity usually employed* varies among different farmers, some applying a ton to three acres, others to four, and many to six, according to the condition of the land, and the goodness of the cake. At the former rate, it is said to have been found equal to 12 loads of dung per acre, and that with 5 cwt. per acre its effects extend to two crops; but that it is more generally limited to the crop to which it is applied, and does not benefit the subsequent ones*. Mr. Curwen used 5 cwt. per acre, mixed with two tons of dung, as a manure for turnips, and found the crop admirable. Fifty bushels of dust make a ton; and the last price at Mark-lane was five guineas.

The *soils to which it is the most applicable* are considered to be clays, and other moist lands; but it is generally thought to be occasionally serviceable to any description of soil. It is likewise said to succeed well in wet seasons, but is found injurious in very dry weather†. To which we add the following trials of its effects, some of which tend to prove that it cannot be beneficially applied to light and poor ground:—

EXPERIMENTS.

The method employed in spreading the manure was this:—The ground being made perfectly smooth and level, a very small furrow, quite straight, drawn with a plough, was first set off, and the drill was set down upon the edge of that furrow—say within about ten inches of it; the distance being regulated by the intended breadth of the turnip ridges. The rape-dust was then filled into the machine, when it was pushed down one side of the furrow, and up along the other side, care being taken to preserve the regular distance, and which a little experience soon rendered the women employed very expert in performing. A plough with a pair of horses followed immediately after the drill-barrow which, with the furrow it threw up, covered the rape-dust, and formed the ridge at the same time; so that, in continuing to run the drill-barrow always within the stated distance of the last-made furrow, and following up with the plough to cover the rape-dust, the business was speedily and satisfactorily finished, with respect to the manuring; after which the turnip seed was sown without delay.

> The first trial was on turnips sown in the month of June. The field in which this experiment was made contains a little more than four acres of a *naturally poor moorish soil.* One half of the field was manured with rich dung, at the rate of nearly 15 tons per acre, and the rape was laid upon the remainder—one half at the rate of 5 cwt., and the other 7 cwt. per acre. Six drills were at the same time left in different places, among those sown with the rape-dust, without any manure whatever, and the following was the result:—
>
> The crop on that part of the field which had the dung was excellent. On the six drills without any manure, none of the turnips exceeded the size of a pigeon's egg. Where they had the 5 cwt. of rape-dust per acre, they hardly were larger than a good apple; and even the 7 cwt. produced a crop that could not be reckoned above a fourth of the value of that after common dung.

In the above experiment no objection was observed to arise from the mode of applying the rape-dust, as the soil was thrown sufficiently thick over it to prevent the seed from being injured, and the plants were equally regular and early in their appearance upon every part of the field.

> The second trial was on land that had a summer fallow as a preparation for a crop of wheat. All the field was dressed with compost,

* Doncaster Report on Bone Manure, p. 30.
† Curwen's Report, p. 66.

and the whole was likewise manured at the rate of 10 double cart loads per acre, with dung of a very middling quality, with the exception of one ridge, containing very nearly 4-10ths of an acre. On that ridge 3 cwt. of the rape-dust was sown broadcast, along with the wheat, in the end of October, and harrowed in along with the seed, the whole field being finished on the same day. Yet during the winter and summer, the crop on the ridge sown with the rape-dust was evidently less vigorous than the rest of the field; and when cut, was perceptibly lighter than an equal portion of the land which had been manured with dung.

The third trial was made on *light, dry, sandy soil*, that was sown with wheat in the beginning of March, after turnips, which were chiefly consumed on the ground with sheep; and on a ridge containing nearly one-third of an acre, exactly under similar circumstances with the rest of the field, 3 cwt. of the rape-dust was sown broad-cast, and harrowed in along with the seed. On this, throughout the early part of the summer, the rape-dust appeared to have some influence, as the crop showed greater vigour on the experimental ridge, than over those adjoining; but when the whole came to be cut at harvest, it was utterly impossible to perceive the smallest difference in the length or thickness of the produce on either portion of the field.

The fourth trial was on a clover ley, the *soil of medium* quality, on which the rape-dust was also sown broadcast, and harrowed in with oats. There 2½ cwt. were sown on a ridge containing very nearly one-third of an acre. Soon after the plants appeared, they evidently assumed a stronger appearance than what the adjoining ridges presented, which had got nothing extra; and during the whole of the summer, the ridge with the rape-dust maintained such superiority, that that when the field was cut at harvest, the experimental ridge was found to have yielded 16 sheaves more than either of the two ridges adjoining*.

It would certainly have been more satisfactory had these experiments contained some details of the state of the weather; and they would also have been more accurate had an equal portion of each of the ridges been weighed and measured, so as to have ascertained the exact produce of both corn and straw. But even the last does not hold out much temptation to the use of rape upon such land, for the increased value of the grain could hardly have repaid the expense of the manure; and if it is only serviceable to one crop, the difference would have been pure loss. We understand, however, that it has been successfully employed to a very large extent upon exhausted land, of indifferent quality, in Kincardineshire; but it was there said to have been laid on in the very unusual quantity, per Scotch acre, of a ton of cake ground into small pieces, and formed into a compost with thirty cubic yards of dried flow moss, and in some cases of peat †;

* Farmer's Magazine, vol. xx. p. 14.

† The mode in which this compost is formed is to remove the moss to a situation where it can be dried, which is generally performed in the winter, and occupies, perhaps, some months. In this state it usually remains until within a fortnight of the time when it is intended to be applied to the land, when it is carefully mixed with the rape-cake, which is placed in alternate layers with the moss, by which a fermentation is occasioned, which, if the weather be favourable, soon increases to such a degree as to reduce even the largest pieces of the cake to a sort of liquid state. In some cases, also, it has been found preferable to mix only half the cake with the moss, about six weeks previous to the commencement of the turnip-sowing, and the remainder within a fortnight of that time; but this occasions the cost of twice mixing.—Farm. Mag. vol. xxvi. p. 37.

the joint expense of which, at the prices stated, including carriage and spreading, could not have cost far short of 8*l.* to 10*l.*—a charge which it is almost needless to observe that no single crop can support. Some farmers also mix the cake at the rate of half a ton with about half the ordinary quantity of farm-yard dung per acre.

The undermentioned experiments, it will be seen, corroborate the opinion of its good effects when applied to strong lands, and also the doubts which we entertain of its profitable application to corn crops, which at once absorb its whole benefit—though turnips, indeed, if favoured by the weather, may support the expense, because the success of the future rotation of crops mainly depends upon that one being abundant, and therefore a farmer can afford to force it, even although the charge may not be reimbursed by its immediate value.

Upon *a strong gravel with a clay subsoil* twelve continuous ridges of summer fallow, each containing above one-third of an acre, were ribbed and sown in October with red wheat, at the rate of two bushels per acre, upon part of which rape-dust was spread broadcast at the undermentioned rates, and the remainder left without manure. Of which the following was the result:—

Ridges. Nos.	Rape. st. lbs.	Market Corn. bush. p.	Wt. per bush. lbs. oz.	Sec. & ref lbs.
1 & 2	59 6	26 ½	52 10	46
3 ,, 4	——	21 3½	50 8	67
5 ,, 6	86 4	28 0	53 4	35
7 ,, 8	——	22 3½	51 2	91
9 ,, 10	125 4	29 2	52 10	36
11 ,, 12	208 0	27 3	52 2	97

From this it appears that the produce of wheat was considerably larger and better on those parts of the field on which the rape-dust was laid, than on those ridges which were left unmanured; though it will not escape observation, that it was neither so large nor so fine in quality where the largest quantity of rape was spread, as where only half the amount was applied. But this leads to a calculation of the profit and loss; and estimating the wheat as worth 8*s.* per bushel, if weighing 56lbs., and deducting therefrom threepence per bushel of the price, for every pound of which that weight was deficient; then valuing the secondary and refuse corn as worth one penny per pound, and supposing the rape-dust to cost, with all charges, 8*l.* per ton, or 1*s.* per stone of 14lbs. when laid upon the ground—the account, exclusive of fractions, will stand thus:—

Ridges. Nos.	Value of Market Corn. £ *s.* *d.*	Do. Seconds and Refuse. *s.* *d.*	Do. of Rape Cake. £ *s.* *d.*	Net Value of Wheat. £ *s.* *d.*
1 & 2	9 4 7	3 10	2 19 5	6 9 0
3 ,, 4	7 4 9	5 7	——	7 10 4
5 ,, 6	10 4 9	2 11	4 6 8	6 1 5
7 ,, 8	7 15 1	7 7	——	8 2 8
9 ,, 10	10 8 8	3 0	6 5 8	4 6 5
11 ,, 12	9 13 5	8 1	10 8 6	0 7 loss.

Which shows that the clear return of cash from those parts of the land which were left unmanured, exceeded, in every instance, that of those on which the rape-dust was laid; and that in the last, its application actually occasioned a loss. From this, however, we do not mean to draw a conclusive inference against its use, because the opinions which we have quoted in its favour are those of men of eminent experience and ability; but we think that farmers who have not already tried it will do well to employ it cautiously at first.

MALT-DUST

Is the refuse which falls from the malt in the process of drying, and is extensively used as a top-dressing, in those counties where the general production of barley occasions the establishment of large malting concerns. It is also in some places employed in the feeding of milch cows and pigs. It varies, however, very considerably in its effects as manure, both in proportion to the quality of the barley, and to the degree of heat employed in the operation of malting; for when the grain is equally good, the pale malt, which undergoes a regular and uniform heat in the kiln, though considered more lasting in its effects, is not so stimulant as that which is high-dried. The browner the dust, therefore, the more active it is found to be in its immediate application—provided the barley from which it is made be of equal goodness. Farmers are, therefore, not unfrequently deceived in their expectations of its powers, from the want of proper attention to these circumstances, for the quantity to be applied to the land should be regulated accordingly.

It has been used with considerable success upon stiff loams, and even on sandy and chalky loams, and other calcareous hungry soils; but upon cold stiff land we should recommend the application of the brown dust, as the most likely to be effectual to the crop in the ground. The accounts given of its influence upon the succeeding crops are by no means favourable, though, in Walker's report of Hertfordshire, it is said that "these top-dressings not only supply the want of previous manure, but also, when crops are sickly and backward in the spring, occasioned either by bad seed-times, frosts, or other causes, are attended with wonderful success, and enable the crops to vegetate quickly, and cover and protect the soil on which they grow from the droughts of summer." He states, indeed, that the farmers of that country are chiefly indebted to its effects for their never-failing crops: and that, therefore, they continue to enlarge upon the practice, though attended with considerable expense. To which Mr. Malcolm adds, "that he has seen an untoward season so injure the young barleys as to nearly annihilate the crop, which had been previously dusted, but which was afterwards entirely recovered by a repetition of the malt-dust; which shows, that although from some ungenial circumstances the first manuring had not been attended with all the success which might have been expected, yet it clearly proves that we should not be afraid of a second application, which is often attended with more than ordinary success*." He, however, advises to be laid on in the following quantities:—

If top-dressed, for wheat, from	36 to 40 bushels.
If drilled with the crop, for barley and turnips	30 to 34 „

according to the strength of the soil. Mr. Young says generally from 40 to 60 bushels; and states that it greatly improves cold grass land †: notwithstanding which high authority, we recommend them to weigh the cost against the probable increase of produce, before they apply it. For wheat, it should be laid on some time in March, just before the usual change of the weather, and should be harrowed in with light harrows. For barley and turnips, it is usual to sow it in with the last harrowing of the seed, and then to finish by rolling. The common price at most malt-kilns is from five to six shillings per quarter.

* Comp. of Modern Husbandry, vol. ii. p. 172.
† Essay on Manures, Bath Papers, vol. x. p. 182.

Chapter XXII.

MISCELLANEOUS MANURES (*continued*).—PEAT-MOSS.

PEAT-MOSS,

Which is universally considered as an inert mass of half-corrupted vegetable matter, has been long applied to land in different ways, and, when burned, has been already treated of in the Chapter on Ashes*. When reduced to that state, it is of course rendered light by combustion, and consequently so portable as to be easily conveyed to any part of the kingdom; but it is only in the immediate neighbourhood of bogs that it can be used in its natural state, for, even when dried by exposure to the air, its bulk is too great to admit of its being carried to any great distance, unless at such expense as would render its application as manure unprofitable.

It has been extensively used in its natural state in both Scotland and Ireland, in various parts of which there are large bogs, as well as in some parts of this country: it is, however, very sluggish in becoming reduced, and requires two or three years, with repeated turnings and exposure to the atmosphere, to bring it to anything like the condition of vegetative mould; but being of a cold nature, it is found, by a heavy dressing, to cause considerable improvement in hot, gravelly, and sandy soils. When brought to the decayed condition of *bog-mould*, or rich earth, it has also been found highly useful in opening stiff clay land, and has been largely used for that purpose in Ireland; but on mellow friable soils, it is stated to possess too little substance to be of much utility, and it is said that it inclines grass-land to the production of moss. It is likewise impregnated with noxious roots and seeds of aquatic grasses, which, when laid on in its raw state, fill the land with those nuisances; and some farmers who have thus applied it, have occasioned such injury to their grass-land, that it has not recovered for several years: though a small quantity of quick-lime sprinkled sparingly over the surface, after the peat is spread, has been known to correct its bad effects †.

During many years it has been the practice of farmers residing in the vicinity of fens, to bed their cattle upon dried peat, as they find that the dung and urine occasion it to ferment and become decomposed. This is so common in Ireland, that every peasant who has a few acres of ground, bottoms his dung-stead with stuff drawn from the bogs, that he may thus preserve the *seep* or *gooding*, as he terms it, of his stable-manure. They also mix the peat with dung in various proportions—sometimes one-third of the latter, at other times one-half; and in the latter case have in most instances found that the mixture has produced an equal crop with a similar quantity of stable-dung ‡. In countries where peat-moss cannot be readily obtained, a proportion of moory soil may be substituted; but it is not advisable that either of these should form the principal part of the compost heap, for neither of them contains fertilizing properties of sufficient power to act in any other way than as alteratives, until effectually decomposed by being judiciously blended with stimulating substances §. The difficulty of

* Chap. XV., p. 334.

† Russell's Treatise on Chem. and Pract. Agric., p. 163.—Lambert's Observations on the Rural Affairs of Ireland, p. 20.—Burroughs on Practical Husbandry; Essay, No. II. p. 44.

‡ Survey of the Barony of Loughinsholin, in the county of Londonderry; and of Renfrewshire, pp. 134, 135.

§ Burroughs on Pract. Hush.—Essay, No. II. p. 43.

effecting this decomposition led to frequent disappointment in the application of the manure, and consequently to much difference of opinion regarding its value, until the late Lord Meadowbank happily overcame the objections to its use, by a scientific investigation of its properties, and directions for its preparation in composts with dung, of which the following is a summary*.

COMPOSTS.

The peat of which the compost is to be partly formed should be thrown out of the pit some weeks, or even months, previously, in order to deprive it of its redundant moisture†. By this means it is rendered the lighter and less compact when made up with fresh dung for fermentation ; and accordingly, less dung is required for the purpose than if the preparation be made with peat recently dug from the pit It should be taken to a dry spot, convenient to the field which is to be manured, and placed in a row of the length intended for the midden. When ready to be made up into compost, half the quantity of dung must be carted out, and laid in a parallel row at such a distance as will allow the workmen to throw the rows together by the spade: the compost may thus be laid in the centre, and will form the area of the future heap, which is to be thus formed.

Let the workmen make a layer or bottom of peat about six inches deep, and extending further than the base of the proposed midden, which is to be thrown up in alternate layers—first, ten inches of dung over the peat, then peat six inches, dung four inches—thus diminishing each layer of dung until the heap rises to a height not exceeding between three and four feet, when the whole should be covered—top, ends, and sides—with the remains of the peat; the whole to be put loosely together, and made quite smooth.

In mild weather, seven cart-loads of common farm-yard dung, tolerably fresh made, is sufficient for 21 cart-loads of peat-moss ; but in cold weather, a larger proportion of dung is desirable. The dung to be used should either have been recently made, or kept fresh by the compression of cattle or carts passing over it; and as some sorts of dung, even when fresh, are much more advanced in decomposition than others, it is necessary to attend to this, for a much less proportion of dung that is less advanced will serve the purpose.

After the compost is made up, it gets into a general heat, sooner or later, according to the weather and the condition of the dung: in summer, in ten days, or sooner; in winter, not perhaps for so many weeks, if the cold is severe. It always, however, has been found to come on at last; and in summer it sometimes rises so high as to be mischievous by becoming fire-fanged. Sticks should therefore be kept thrust into different parts, as by drawing them out occasionally the progress of the fermentation may be ascertained ; and if so rapid as to approach to blood-heat, it should be either watered or turned over, and a little moss be added. The heat subsides after a time, and with variety proportioned to the season and the perfection of the compost ; but, when cooled, it may be allowed to remain untouched till within about three weeks of being wanted: it should be then turned over, upside down, and outside in, and all the lumps

* The credit of this discovery is, however, denied to Lord Meadowbank, in Mr. Shirreff's Survey of the Orkney and Shetland Islands ; in which it is said that "the practice of forming these composts, in the very way described by his lordship, has been known and followed by the Orcadians for many years—probably centuries."—p. 116

† The rich coarse earth which is frequently found on the surface of peat is too heavy to be admitted upon this compost, but makes an excellent top-dressing if previously mixed and turned over with lime.—See Malcolm's Comp. of Husb., vol. ii, p 157.

stated is carried through until it is ready to be laid upon the land. When made up in January, such composts are generally in good order for the spring crops; but this may not happen in a long frost. In summer, they are ready in eight or ten weeks; but if there should exist any necessity for hastening the process, that can be effected by a slight addition of ashes, rubbish from old buildings, or of lime slaked with foul water, and applied to the dung while the compost is being made up.

Doubts have arisen respecting the proper season of laying on this manure—some insisting that it should be applied to spring crops—others, that it should be ploughed in for wheat in the autumn; but we believe that its effect upon the land will, in the long run, be found in either case equal.

Chapter XXIII.

MISCELLANEOUS MANURES (*continued*).—SEA-WARE—KELP—REFUSE FISH—BLUBBER AND TRAIN-OIL.

These manures being chiefly confined to the use of farmers resident in the vicinity of our coasts, necessarily do not engage much of the attention of those who dwell in the interior of the country; but they are of considerable importance wherever they can be procured with facility, and therefore deserve a place in any general account of the husbandry of the United Kingdom.

SEA-WARE,

or *tangle*, in many of those districts, forms an article of constant application, and when used with judgment, never fails to add to the fertility of the land. On some parts of the coast immense quantities are thrown up by the tide, when aided by favourable gales of wind; and in those situations where experience teaches its value, it is seized on with great avidity as a sure means of increasing the crops to which it can be applied; while, in other places, either from the ignorance of the farmer, or in some cases from the want of means and hands to assist in securing it, it is either wholly neglected, or applied to other purposes than those of manure. Thus, in the Orkneys, the Western Islands of Scotland, and on the coasts of Ireland, it is almost solely employed in the manufacture of kelp, and is even used in a dried state as fodder for cattle. In the Isle of Thanet, when a large quantity is driven ashore after a gale of wind, the farmers set all hands to work to get as much as possible while the tide serves, lest the current should carry it away; and even if it happen in the night, they work at it till stopped by the flow of the sea. It is carted through sloping passages cut in the cliff, and some farmers will thus procure as much as 200 or 300 loads in one tide, for it sometimes comes in quantities that amount to many thousands, and is perhaps all swept away by the next ebb. Those who live at a distance, therefore, hire small spots of ground on which to lay it, and carry it away at a more convenient opportunity. The principal mode in which it is there used, is by mixing it in layers among the farm-yard dung; and it is of great use in helping to rot the litter carried out of the yard in summer*.

We have, indeed, already seen proofs of its value in composts in the

* Boys' Survey of Kent, 2nd edit. p. 160.

experiments Nos. 1 and 2, mentioned in the last chapter, to which we add another made at Goodwood, the seat of the Duke of Richmond, in Sussex :—

> Six waggon-loads of sea-weed were mixed with one load of lime-shells in the beginning of August. In the September following, the heap was turned over, and twice again before the end of October, when it was reduced one-third in bulk, and wore the appearance of earth and lime, mingled with some streaks of white, which were very salt, and was then laid upon the land as a top-dressing to wheat, and the crop exceeded five quarters per acre.

Notwithstanding this evidence in its favour, yet, when the land is in a fit state to receive it, it is found the best practice, both in point of economy and effect, to cart it directly upon the ground, and spread it immediately while quite fresh; for experience has shown that, if left in heaps, its most valuable particles are very speedily absorbed by those spots on which they are laid, and the ground is thus only partially enriched. It has been sometimes suffered to ferment before it is used; but this appears to be wholly unnecessary, for there is no fibrous matter to dissolve, and some of the properties of the manure are thus lost *. However, where it cannot be immediately applied, it may either be advantageously mixed with long dung, or laid upon a flattened heap of earth to form a compost.

Sea-ware, although thus valuable as a manure, is yet only transient in its effects, which do not last more than the crop †; nor can it be applied with any advantage, either to clay soils or in very wet weather. To light land of any description it is, however, well adapted; and it is very beneficially applied to summer fallows. When spread on grass land, it is also found to improve the herbage, but it should be spread evenly, and rather thinly. On arable, there is no certain rule for the quantity which may be laid on, for it may be employed to almost any moderate amount without injury.

KELP

is made from burnt sea-ware; but since the admission of foreign barilla, the manufacture has nearly ceased throughout the United Kingdom, and it has become a matter of great importance to a very numerous class of poor and industrious persons, formerly employed in its production, to discover any useful purpose to which it can be applied. It requires about 30 tons of the weed in its wet state to produce one ton of kelp, and it is said to resemble peat-ashes in its effects. At the late prices, the cost, when ready for delivery, was, however, seldom under 3*l.* 10s., which is more than the price of the best Newbury or Dutch ashes ‡. If the properties of kelp only resemble those of the stronger kind of ashes, the rate must, therefore, be reduced, or it cannot be brought into general use as a manure.

This representation of its qualities we, however, imagine to be erroneous, for 20 bushels of kelp per Scotch acre having been lately laid in drills by Mr. A. K. Mackinnon, of Corry, in the Isle of Skye, upon dry stony ground, afterwards sown with turnips, the effect of which was so unfavourable to that crop as to show that the quantity used was far too great; though Dutch ashes are commonly used at the rate of full 24 bushels upon the same extent of ground. The account says, that "it came up in patches;

* When applied in a fresh state to garden ground, it is said, in the General Report of Scotland, that very large crops of onions have been thereby raised.—vol. ii. p. 94.

† Sinclair's Statistical Account of Scotland, vol. vii. p. 202.

‡ See Chap. xv. pp. 334 and 336.

and upon a careful investigation of the cause, it was discovered that wherever the ground was deepest, and the ashes of the sea-weed (kelp) had been most mixed up with the soil, the turnips were best; and on the other hand, that where the ashes, not being mixed with the soil, came in contact with the seed, the turnips did not at all thrive." Another trial was therefore made last year, with a mixture of kelp and peat-ashes, (the quality of which however is not stated,) the result of which was, that a field of six acres having been sown down with the compost at the rate of 6 bushels of kelp-ashes and 24 of peat-ashes to the acre, the turnips, though not sown until the first week of August, have grown remarkably well; and, at the time of writing the account—within little more than two months from that of sowing—their average weight was from 2¼ to 2½ lbs.*

Kelp when intended for use as manure is pounded into a powder, and applied in the same manner as the ashes; but its causticity affects the hands of the workmen, and when spread as a top-dressing, it is, therefore, prudent to mix it with an equal quantity of fine sand, which both prevents that injury and facilitates its equal distribution. In this way it has been already employed with considerable advantage, as appears by some other experiments detailed in the Prize Essays of the Highland Society†, from which the following are extracts:—

1. Upon a sandy loam, sown with oats, and which had also borne a crop of oats the preceding year, kelp was spread in the month of March at the rate of 3 or 4 cwt. per Scots acre. On one part it was left as scattered upon the surface; on the other, it was slightly brushed into the soil, and the remainder of the field was manured with stable-dung. The crop on both the parts which were dressed with kelp was fully equal, if not superior, to that which was dunged; and on that portion on which the kelp was brushed in, it was better than the other. The kelp on the surface also decomposed more gradually than that which was more buried, and it appeared that the process required to be hastened by moisture.

2. A similar quantity of kelp was laid upon young clover and rye-grass, which was evidently more luxuriant during the summer than where it was not spread, and the crop, though not weighed, was supposed to produce more hay to the amount of about 7 cwt. per acre. The after-crop was also better. The same effect was produced upon the gravelly part of a field of old pasture.

3. The same amount per acre was spread as a top-dressing upon wheat, sown upon a clay soil, and the increased product of the crop upon the kelped part of the field was so conspicuous, that it was supposed to have arisen from some other cause.

4. An unweighed quantity of kelp was used in raising turnips; but there is reason to suppose that the experiment was not accurately conducted, for it was not sufficiently pounded, and it was obvious that a much larger quantity than was necessary had been applied. Instead of being mixed with the soil, it was also laid in the drills, and the seed sown upon the top of it; hence its acrid nature was, in dry weather, injurious to the young plants; but towards the close of autumn, after there had been much rain, they recovered, and at the end of the season, when the other turnips were growing ripe, those upon the kelp were becoming vigorous.

There does not appear to have been any opinion formed of its further

* Prize Essays of the Highland Society, New Series, vol. i. p. 317.
† Ibid., vol. iv. p. 245.

effects upon the land in succeeding years; but if it produces an increased quantity of fodder in the first, it will necessarily add to the farm-manure in that which follows, and must tend to the improvement of the soil. From the observations which have been made upon these, as well as upon other experiments, it is thought that kelp should be spread as early in the spring as possible, and that it should be slightly covered with the earth, so as to keep it damp, and unexposed to the influence of the air. In applying it to raise turnips, it is also apparent that it should be mixed with a portion of the soil in the drills before the seed is sown upon it, in the same manner as recommended in the sowing of rape-dust. On light warm soils, it is imagined that 4 cwt., or even less, per statute acre, would be sufficient; but that, on heavy lands, an increased quantity might be required.

REFUSE FISH

Large shoals of herrings, pilchards, and other sea-fish, periodically frequent many parts of the coasts of Great Britain, which, being salted, leave great quantities of refuse, which are used as manure*. Sprats, and other small fry, are also employed for the same purpose; and in the fens of Lincolnshire and Cambridgeshire, the small fish called sticklebacks abound in such swarms, that they are frequently purchased by farmers at very trifling cost, and either formed into composts with earth, or laid upon the land without further preparation. One barrel of such offal is mixed in about 4 or 5 cart-loads of earth, sweepings of ditches, or sand; and after being well incorporated, the compost is usually applied at the rate of about 20 cart-loads per acre, more or less, according to the quantity of oil contained in the garbage.

The effects of a compost when thus prepared have been known to last for a considerable time, and when laid as a top-dressing upon grass-land, has produced very large crops; but when applied in that manner in its natural state, it is often prejudicial to the first crop, and not very beneficial to those which follow †. It should, therefore, in every case, be either made into a compost, and completely decomposed; or, if ploughed into the land without that preparation, it should be mixed with a small quantity of quick-lime or strong ashes, for all oily substances are hurtful to vegetation until they are dissolved. We hear, indeed, of a crop of wheat having been rendered so rank in straw by the application of herrings in a raw state, that it was entirely laid before harvest; and sprats are said to produce great effects for one year upon the hop-grounds in the neighbourhood of the Medway ‡; but we have no information regarding the state of the soil, nor the time of the year, when the former were ploughed into the ground, nor whether the latter had not also been laid upon the land together with some alkaline manure.

BLUBBER.

Whales, when killed in the Greenland fishery, are cut up into great junks, and packed in the ships until the completion of the voyage, when

* In Scotland, it is calculated that 14 barrels of herrings yield one barrel of refuse: pilchards, something less, but containing rather more oily matter; and there are, besides, large quantities wholly spoiled. To which may be added, the entrails of the cod and ling, which are caught and salted to a vast amount in the north.

† The manure produced in the fishing villages from the oily and fishy substances, though admitted to be favourable to bear (barley) and green crops, yet when much used, is said to render the soil unfit for the production of oats: "Hence that soil is called poisoned."—Sinclair's Statistical Account of Scotland, vol. vii. p. 201.

‡ Treatise on Soils and Manures, Anon. p. 115. Sinclair's Code of Agriculture, 3d Edit. N. p. 227.

the oil is extracted by the process of boiling, and the substance which remains is called blubber. This is of no other use than as manure, for which purpose it is therefore employed by farmers in the neighbourhood of the fishing stations, by whom it is invariably made up into compost, generally with earth; for when applied in its crude state, instead of assisting, it destroys vegetation. Caution is, therefore, requisite in its application; for if laid upon the land in too large a quantity, even in the state of compost, it will do more harm than good; but if mixed at the rate of not more than one ton of blubber to 20 tons of mould and one chaldron of lime, well pulverized, and turned during three or four months, it is then found a very rich manure for both arable and pasture land, when laid on to that amount upon the average of soils, or in such other quantities as the quality of the land to be manured requires. Such are the directions for its application given by Mr. Morley, of Blickling, in Norfolk, formerly farming bailiff to Lord Suffield. The following are the results of twelve years' experience of another intelligent farmer :—

His plan is to make it into a compost in the proportion of nine loads of earth to one load of blubber. He first makes a layer of earth two feet deep, of length and breadth in proportion to the quantity of manure to be prepared; building it a foot higher at the sides, like a solid wall, to form a hollow space, at about three feet inwards, for the reception of the blubber, which is then laid on a foot in depth. On this another layer of earth is laid; and similar layers are repeated to a convenient height, till all the blubber is expended, leaving three feet of earth for the top layer. The entire heap is then beat down close at the top and sides to exclude the air; and in this state it will soon ferment. When this fermentation abates,—which it will do in about two months,—the heap is turned over from top to bottom; the bottom layer, in consequence, becomes the top, and requires some addition to prevent the escape of the air of this second fermentation. It is again turned over when that abates; and after a third fermentation, it becomes fit for use, but is never employed until from nine to twelve months old.

When in this state, he has applied it to both grass and tillage land, at the rate of about 20 or 30 tons per acre, and has cut from the grass-land three tons of hay per acre—aftergrass in proportion. It has also been used annually on an arable field of 20 acres, from which he has reaped the following crops per acre, in succession :—

5 Quarters of beans.
5 do. wheat.
325 to 375 bushels of potatos.

The land a strong clay; but this constant manuring renders it difficult to avoid fallowing, for the blubber encourages the growth of short twitch grass. He never employs lime in the compost, as he finds it reduces the blubber, and prevents fermentation*.

OIL.

As all writers on the application of train-oil and blubber, as manure, agree in their opinion that it should be made into compost with a large portion of earth†, and the experience of practical men in this country has proved its correctness, we do not think it necessary to enlarge on the subject, further than to remark, that in some parts of the continent, oil has been

* Treatise on Soils and Manures, Anon. p. 113. Farmer's Mag. vol. xvi. p. 278.

† Dr. Hunter advises, in his Georgical Essays, a compost formed of 12lbs. of American potash dissolved in 4 gallons of water, mixed with 20 bushels of dry mould and 14 gallons of train-oil.

found highly fertilizing when applied to the land in its liquid state, diluted with a sufficient quantity of water, and spread moderately over the surface. We shall therefore only add the following experiment, made by Mr. Mason, of Chilton, as mentioned in an account furnished to the Doncaster Association by Lord Althorp :—

> To one acre of a tenacious soil, sown with turnips, he applied 40 gallons of unrefined whale-oil, which cost 8½*d.* per gallon, mixed with 120 bushels of screened soil, and prepared one month before it was used.
>
> On another acre, 40 bushels of bones, broken small, and mixed with 80 bushels of burned earth, were also laid, and the comparative result was as follows :—

	Tons.	cwt.	st.
Oil and screened earth—crop	23	5	6
Bones and burned earth ,,	21	18	6

This makes, as observed in the report, a " decisive difference in favour of the soil and oil* :" on which we, however, beg to remark, that although the difference of expense is also considerably in favour of the oil, yet the soil to which it was applied was more favourable to its application than to the bones ; nor can the experiment be justly considered as decisive, until the future effect of the two composts be ascertained by the comparative produce of the succeeding crops.

Chapter XXIV.

MISCELLANEOUS MANURES (*continued.*)—FELLMONGERS' POAKE AND CUTTINGS—TANNERS' BARK.—WOOLLEN RAGS AND FURRIERS' CLIPPINGS.—SUGAR SCUM.

In consequence of the improvements in husbandry, occasioned by the additional value which farm produce experienced during the late war, attempts, which in former times were little thought of, were very generally made to increase the natural powers of the soil by the application of every refuse vegetable and animal substance that could be converted into manure. Among these are some of those which form the subject of the present chapter; but, being only procurable in the neighbourhood of towns, and consequently not at the disposition of all husbandmen, we shall only touch upon them slightly.

FELLMONGERS' POAKE,

which is the waste arising from the preparation of skins, is compounded in various proportions of lime, oil, and hair, and is of such a caustic and heating nature, that it is rarely used in any other state than that of a compost with earthy substances, and sometimes, when it is thought expedient to increase the powers of farm manure, also with stable-dung. To form this, whatever materials are intended for the compost should be mixed together in a heap, surrounded with maiden earth, and covered, when it begins to ferment, with soil made fine and sloped so as to throw off the rain. When the fermentation has nearly subsided, it should then be turned over, and if some fresh litter be mixed with it, the midden will again immediately heat; after which, it may be again turned in three weeks or a month, and in about six weeks more, it will be fit for use.

* On Bone Manure, p. 31.

In this state, it is well calculated for cold and tenacious soils, as well as for loams of every description, and when laid on at the rate of 12 to 16 tons per acre, according to the strength of the land, it has been known to produce heavy crops for four or five years successively. It has also been applied, in its unprepared state, as a top-dressing to sour coarse meadow, with very good effect; and after having lain three or four months on the field, and having been frequently moved about with the brush harrow, it has then been raked up, and laid upon the dung-heap. There can, however, be little doubt that much of its valuable properties must have been thus exhausted by the atmosphere; which, if it had been made up in the first instance into a compost, would have been preserved.

The *clippings*, are the parings and scrapings of the skins, which, although generally used in the manufacture of glue, have been in many instances used as manure. When ploughed in upon a summer fallow for wheat, these clippings have been found highly serviceable to deep loamy land, and to strong soils which are not too wet, for they not only produce a full clean grain, with a bright strong straw, but the bulk of the crop is also greatly increased. Care should however be taken to cover them well with the soil; for, if left near the surface, the putrid effluvia, which they soon emit, attract the crows in swarms, and great quantities are thus scratched out of the ground. From 30 to 40 bushels is the quantity usually applied to an acre, but the price varies in different places from 4*d.* to 9*d.* per bushel, heaped loose.

TANNERS BARK.

The refuse of the tanneries consists partly of the same substances as fellmongers' poake; but when the bark is used alone, it is chiefly employed in gardens, as a covering for the beds of pineries, and in that state has been found quite ineffectual as manure. It has, however, in some instances been made up as a compost with lime, chalk, earth, and dung, and laid upon strong land with considerable advantage. It might, indeed, be supposed that the whole value of the mixture consisted in the latter article; but, according to a long account of a series of experiments made by Mr. Malcolm, and recorded in his Compendium of Modern Husbandry *, the bark would appear, by the comparative trials, to have had much good effect in the composition. When mixed with lime, great care is however requisite to prevent it from catching fire during its fermentation, for which purpose it should be so completely covered with earth as wholly to exclude the air. It will, in some cases, particularly if much mixed with earth, take three or four months to ferment; when it should be turned over at least once; which further fermentation and cooling will probably require a couple of months longer before it can be in a fit state to be laid upon the land.

The following were the different modes employed by Mr. M. in the preparation of these composts:—

1stly. To four waggon-loads of fresh small bark, an equal quantity of long horse-dung was added, and let to lie for three weeks; during the whole of which time, the moisture in the bark kept the dung fermenting.

2ndly. To the same quantity of bark and dung, 20 bushels of quick-lime were added. In about four or five days, the dung, having fermented, caused the lime to slake, and set the whole on fire, by which the dung was consumed; but the tan, though altered in colour, was not much injured.

* Vol. ii. p. 93.

3rdly. To the same quantity of bark, dung, and lime, 40 bushels of earth were added, as a cover: the fermentation of the heap soon made it sink; but as the air was not entirely kept out, it took fire in one place, and was partially burned.

4thly. To the same quantity of bark and dung, 20 bushels of chalk were added: the bark and dung fermented strongly, and the chalk fell to pieces like powder.

5thly. To the same quantities of bark, dung, and chalk 40 bushels of fresh maiden earth were added.

When the sensible fermentation had ceased, the heaps were all turned over and well mixed, at three different periods, at about a month's distance between each; after which, they were laid in different lots upon a coarse and strong loam, rather shallow, upon a clay, with a lower stratum of chalk. The manure was then partly ploughed in, and partly top-dressed, and spit-dung, soot, and cinder-ashes, were also separately applied in a similar manner, as comparative experiments. The land was sown with turnips, followed by barley and clover, the whole management of which is more minutely detailed than we have space to transcribe; but the result was, that the compost of bark, dung, lime, and earth, was throughout the best. It also appears, that the top-dressings did not succeed so well as the manure that was ploughed in.

It thus seems that rotten bark may be advantageously mixed in a compost with lime and earth; and as in many cases it is such an incumbrance to the tanners, that they are glad to get it taken off their premises without charge, it may be worth the while of farmers in their neighbourhood to try its effects. Mr. Malcolm, however, has not stated the rate at which it was applied to his land; nor does he express any decisive opinion respecting the quantity in which it should be employed: but we imagine it may be properly made to depend upon the quantity of lime which may be safely used upon the soil, for we apprehend that an excess of the bark will not occasion injury.

WOOLLEN RAGS AND FURRIERS CLIPPINGS.

Rags are sometimes used in considerable quantities upon light chalks and gravelly soils, to which their retention of wet renders them particularly applicable, and they continue to act so long as they remain unrotted in the ground. They require to be cut into pieces, and are sometimes spread upon clover-leys and ploughed in for wheat when sown upon one ploughing. Their chief use is, however, to lay them in hop grounds, for as they act in the nature of a sponge, they preserve the plantations in a constant state of moisture in the dry seasons, when in land which has been manured with dung the hops have failed; but in rainy seasons they, on the contrary, have been known to do injury by creating mould. The usual method of thus applying them is, to open the hills and place the rags round the roots, a little below the surface, and immediately to cover them with mould: a ton of rags being the usual quantity to an acre*. They are also frequently employed as top-dressings for clover-leys, and are sometimes ploughed into the land before winter, when intended for turnips; for, if applied at the time of sowing, they will not work for that crop †. If used for other crops, they should be spread before the last ploughing, and laid well into the soil, or otherwise they are apt to be raked out by the harrows. We have also heard of their being steeped in a reservoir of urine, kept in the farm-yard, and applied to barley and clover with very good effect.

* Surveys of Kent, p. 161; of Sussex, 219.
† Young's Survey of Oxfordshire, p. 266.

They are usually sold by the ton, at various prices, from 7*l.* to 10*l.*, and, for common purposes, are generally laid upon the land at the rate of 6 to 8 cwt. per acre; but no rule is necessary to be followed in their application, as an increased quantity can do no other harm than dipping a little deeper into the farmer's pocket.

Furriers' refuse, or *clippings*, are employed with the same intent as woollen rags, and applied to soils of the same description; but they are usually sold by the quarter, which commonly contains as much as two five-bushel sacks will hold when closely pressed. The price is said to be about 14*s.* to 16*s.* per quarter, and the quantity usually applied 24 to 30 bushels per acre*; but they are little used, and the information respecting them is not to be strictly relied upon.

SUGAR-BAKERS' SCUM

is the skimmings of the sugar during the operation of refining, in which process it is boiled with a portion of bullock's blood and lime-water. The albumen contained in the blood coagulates on the application of heat, and rises to the top of the pan, carrying with it the impurities contained in the solution which is thus clarified, and the dregs are used as manure. This refuse is of a very caustic nature, and is therefore not well adapted to light soils; nor, indeed, has it been found to answer upon arable land of any description; but it has very considerably enriched meadows of cold retentive clay, and is therefore used to some extent in the vicinity of the great sea-ports which trade with the West Indies.

The mode of applying it is to break the lumps, and to spread it evenly and thinly, if laid on in its raw state; but a better method is to mix two or three cart-loads of road sand with one of scum, and to apply the mixture, without waiting for its fermentation, at the rate of about 30 loads per acre; a few more or less, according to the state of the land. It may be had at most sugar-bakers at about four or five shillings the cart-load, containing at least a ton.

Chapter XXV.

MISCELLANEOUS MANURES (*continued.*)—CLAY—SAND—POND, RIVER, AND SEA MUD.

CLAY.

Such frequent allusion has been already made to the expediency of mixing together different soils of a marked character, as a means of ameliorating their distinct qualities, that it is unnecessary to repeat that recommendation, whenever it can be carried into effect with moderate expense. This advantage is in no case more fully evinced than by laying clay upon sand lands, whether they be of the red, rich, or more valuable descriptions, or those of an inferior quality which usually contain a portion of moor and white sand. On the former, about 50 tons per acre will effect a vast improvement; but the latter are seldom brought into a fertile state with less than treble that quantity. The most eligible period to apply it is in the autumn or early part of the winter, when the land is in grass, and intended to be broken up for a crop of corn; or otherwise at the same period, when intended for fallow. The frost, rain, and drying winds will then cause the

* Malcolm's Survey of Surrey, &c. vol. ii. p. 90.

lumps of clay, however large, to open, and by repeated slight harrowing, to divide and intimately cover the surface before the land is ploughed,—a circumstance of little trouble if attended to at the proper season, though, if not so reduced before the land is ploughed, large pieces of clay will be found to have been preserved from the atmospheric influence, and consequently unbroken and unprofitable many years afterwards. It is more profitable to repeat the operation after an interval of a few years, rather than to lay on an immense quantity at once, as by this means the clay gets more thoroughly incorporated with the sand; and it will be obvious that the first ploughing ought not to be to the full depth, lest the clay be lost. It is, however, scarcely practicable to lay clay, in its natural state, upon sand, both because of the great labour of digging, and afterwards preparing it with the requisite degree of care for mixture. If not rendered so fine as to be perfectly incorporated with the sand, its tendency to sink through light land gradually brings it to the bottom, and renders it afterwards useless, if not injurious, by forming a retentive subsoil.

SAND

is, however, not exposed to the same objections, for it is dug with less labour, and does not require any further trouble in its preparation. Its application as an alterative for stiff clay land is of the greatest advantage; for its intermixture with the soil—which is effected by various means—has a tendency to lighten the land, and to bring it to that loamy state which is the most favourable to the purposes of vegetation. In this respect, its action is the counterpart to that of marl, as applied to light sandy ground; for in both cases it is the interest of the farmer to bring his land into that state which is the most likely to be productive. Marl, by stiffening it, produces this effect in the one instance; and sand, by loosening it, in the other.

Until about half a century ago, this plan was very little known as an improvement to the soil, when a spirited agriculturist in Cheshire began to use considerable quantities; sometimes mixing it with dung, and sometimes laying it raw on his grass-lands. The success which invariably attended these experiments, at length induced several farmers in his neighbourhood to follow his example, and the practice has since been very generally adopted in many of the principal dairy-farms in the middle of the county: deep beds of sand being there frequently met with under the clay, which predominates as the superficial stratum of the soil. The mode of employing it is thus described by a landowner who has employed it extensively with the greatest advantage:—

'When there is a piece of strong clay-land in tillage, and the farmer has an opportunity of covering it over with sand, about twice as thick as in a common set of manure, the soil will be pulverized and opened by this means—will give better crops when in tillage, and when laid down will produce a finer herbage, less liable to be parched in dry, or trod down in wet seasons. It is excellent management in the farmer, before he ties up his cattle for the winter, to lay a coat of sand, at least a foot in thickness, where he intends to throw his dung out of the cow-houses. The dung hould be repeatedly levelled on the sand, and a second coat of the latter aid on towards the end of February; upon which should be put the emainder of the dung procured before the cattle go to grass. As soon fter this time as possible, the compost should be either turned and well mixed where it lies, or filled into the dung-carts, and taken away to some situation near the land on which it is intended to use it. Here it should be laid in a heap of at least two yards in thickness; and after remaining two

or three months in this state, it is in excellent condition for putting on the land.' *

This, however, only alludes to its employment as a compost; but if laid in its natural state, either as a top-dressing upon meadow of a stiff nature, or slightly ploughed in upon heavy arable land, it will be found to effect a permanent improvement in the soil. It must, in the latter case, however, be laid on in very large quantities; perhaps not less than two to three hundred cart-loads, or cubic yards.† This, of course, cannot be accomplished with prudence, unless the sand lies either under the clay, or in the immediate vicinity of the farm; and even in that case, the expense of cartage, if calculated at its cost in money, would appear too serious to admit of much chance of profitable remuneration. Many circumstances are, however, continually occurring on every farm to prevent the constant occupation of the teams: on those days they may be invariably employed in the cartage of the sand, without any charge except that of day-labourers to dig; and if it cannot be immediately spread upon the land, it may be laid up on the headlands of the field to which it is intended to be applied.

MUD.

The *mud from ponds*, when they are cleaned out, has always been an object of attention to farmers, so far as regards its collection; but it must be presumed that its different properties, and consequently the most judicious mode of its application to the land, are either but little understood, or neglected; for some cart it directly upon the ground, and plough it in either for turnips, or for corn-crops; others spread it upon old leys; and many lay it out in thin heaps to dry, after which they mix it with lime, chalk, or dung. Upon this it has been remarked by an eminent agriculturist, 'that in reasoning with the farmers upon the cause or principle by which they are guided in those different proceedings, the reply is generally, "that it has been their practice to do so—that it has answered very well—and that they know of no better mode of treating it." From which we are necessarily led to conclude, that upon the same, or nearly the same sort of soil, these different practices cannot be right. It therefore becomes necessary to consider what is the usual composition of the sediment in ponds,—then to point out, as correctly as we are able, the best way of preparing it for use—the soils to which it should be applied—and the crops which ought to succeed such application ‡.'

Upon this it may be observed, that ponds, being usually placed at the lower part of the fields, receive after every hard rain a part of the soil, as well as of the substances with which they have been manured. If the ponds be large and deep, they may also acquire much decayed vegetable matter, arising from the aquatic plants with which such pools usually abound; and if near to the yards at which cattle are commonly watered, they must likewise receive a portion of their dung: such mud is, therefore, particularly applicable to light soils, both as containing nutritive matter, and adding to the staple and consistency of the land. If, on the contrary, the ponds contain springs, the sediment taken from them will be found unfit

* Holland's Survey of Cheshire, p. 231.

† It has been laid on a large extent of drained moss, in Dumfriesshire, at the rate of a single-horse cart-load to every square yard of surface, though the land was in such a soft state that the sand could only be carted by horses with wooden clogs or pattens on their hind feet. The expense must, therefore, have been enormous; yet the improvement in the land seems to have reimbursed the proprietor.—See Dr. Singer's Survey, p. 309.

‡ Malcolm's Comp. of Mod. Husb., vol. ii. p. 116.

for vegetation, for it contains more sand than vegetable matter, and it hardens upon exposure to the sun; it may, however, be useful in killing the rushes and coarse weeds upon low sour meadows, but prejudicial if applied to uplands. It is therefore evident that the mud must partake of the nature of the various ingredients of which it is composed; and therefore every farmer should take these circumstances into consideration before he applies it to his ground.

The most common time of mudding ponds is during the summer months, when it is usual to let the slime lie near the edge of the pond until the water is drained from it. A spot is then marked, either upon a headland of the field upon which it is to be laid, or as near to it as possible, of a size to raise a compost with alternate layers of either lime or dung. If dung can be had, the best mode of preparing this manure is to lay a foundation of mud, of about a foot or a foot and a half in depth, of an oblong form, and not more than eight feet in width, upon which the freshest yard dung is laid to about double that depth; then a thin layer of mud; after which, alternate layers of mud and dung, until the heap be raised to about five or six feet in height—keeping the sides and ends square, and coating the whole with mud. It should then be left to ferment; after which it must be again turned, at least twice, at different periods.

If quick lime be used, and there remains any moisture in the pond scourings, it will be sufficiently fallen for turning in a few days,—but if the compost be made with farm-yard dung, it may require to remain for six or eight weeks to ferment and decompose before it is in a proper state for turning. To derive the greatest advantage from composts, it is necessary to mix them thoroughly, which can only be effected by repeated and careful turnings. To form them, in the first instance, with both quick lime and manure is injudicious: the former ought never to be brought into contact with the latter—though manures may be advantageously incorporated with an old compost, in which a little lime has been used.

These composts may be applied at the rate of 16 to 20 cubical yards for strong loams, and upon light loams in a rather smaller proportion. Pond mud is however not unfrequently used, in an unprepared state, upon grass-lands; but the accounts given of its effects are so different, and the experiments are so inaccurately stated, that we might mislead our readers were we to detail them. Were attention paid to the properties of the mud, and to the quality of the soil on which it is to be laid—in the manner already alluded to—there can, however, be little doubt that errors in its application might be avoided. It appears the better mode to apply it in the latter end of autumn, or the early part of winter, and to bush-harrow it well after it has been hardened by the frost*.

River Mud in creeks, or banks, from which it can be collected, answers the same description, and is also extensively employed in some districts in the operation of warping, which will be noticed hereafter.

Sea Mud, or *Sleech*, has also been used in some places in very large quantities, and has been found of so very enriching a nature, that it was thought worth while to carry it in barges up the river Mersey, to the estates of the late Duke of Bridgewater, at Worsley, in Lancashire†. It abounds at the mouths of many of the friths and rivers which run into the sea; and one gentleman, who has used it for upwards of half a century in Cheshire, asserts that no other manure is equal to it either for corn or grass. It is there, however, always laid upon grass, and ploughed in without any addition in the following spring. If the ensuing March be dry, and there has been

* Farey's Survey of Derbyshire, vol. iii. p. 187.

† Sinclair's Code of Agriculture, 3rd edit. p. 242.

much frost in the winter, a heavy pair of harrows will prepare it for the plough; otherwise, it must be chopped with spades. The land is then generally sown with oats, followed by barley or potatoes, and the third year by wheat. The fourth year the land is laid down either with oats or barley, clover and grasses, and the crops are said to be very great. It is also found that its effects remain longer on the land than marl: and although that which is over-marled is spoiled for grass, yet that never happens to sea-mud*. In many parts of Scotland it has also been found to answer very well for the improvement of moss; upon which, after it has been well drained, the sleech is laid, to the amount of 100 single-horse cart-loads per acre†. To this, however, we must add, that the repetition of it in large quantities fails of its former effects. In Sussex it has been used to the extent of 1200 to 1300 bushels per acre; but on those farms where it has been too frequently used, and which are thus said to have been "over-dosed," it is no longer found to be of any service ‡.

Chapter XXVI.

MANURES IN GENERAL.—PUTRESCENT, MINERAL, AND MISCELLANEOUS.

We have devoted a large portion of this publication to the subject of manures, both because, in the present state of agriculture, arable land cannot be made to pay the expenses of cultivation without the most skilful and economical, though unsparing, use of the various kinds, and because it is notorious that a great number of farmers are either ignorant of the most judicious mode of their application, or negligent of the means of their increase and preservation. The latter remark applies more especially to farm-yard manure, which no one can ride over any part of the country without seeing wasted—dung carted out of the yards and thrown up by the side of some lane without any foundation or further care, until, perhaps after having become mouldy and firefanged, it is at length turned over, while the best part of its juices have been allowed to run into the ditches, or to stagnate around the heaps; thus, neither assisting the proper fermentation of the dung, nor mixing the heap at such regular periods as to ensure its being all of one quality §.

We have already stated our opinion so clearly on the subject of fermentation, in our view of putrescent manures, that it may be thought hardly necessary to add any thing to the discussion of the point in dispute; yet, as many farmers have been influenced by the reasoning of chemists, who pos-

* Holland's Survey of Cheshire, App. No. III.

† Singer's Survey of Dumfriesshire, p. 311.—Gen. Rep. of Scotland, vol. ii. p. 353.

‡ Young's Survey of Sussex, p. 218.

§ On this, however, the following remark has been inserted in the Report of the Committee of the Doncaster Agricultural Association upon bone manure—'The general mode of managing fold manure is erroneous, both as to the expense incurred and loss from evaporation. To prevent both, upon carrying it out to the field, it should be forked up to a considerable height, and the whole covered with the soil nearest to the heap; a long heap, like a potato heap, is therefore best; as it accumulates, taking care always to cover the whole of the day's loading, excepting the end to which the next day's work is to be added. The confinement of the steam, which is always observed upon a fresh-made heap of manure, effectually secures the decomposition of the whole; which will cut out like a jelly, *without the usual process of turning over and over*.'—p. 31

sess no practical knowledge of agriculture, in favour of the invariable application of long dung—though opposed by experience—and as it is extremely important that the question should be set at rest, we request serious attention to the following extracts from an able article which has appeared in the Quarterly Journal of Agriculture since the publication of what we had written*. *See* "Farm Yard Manure," in Supplement.

It was promulgated as the opinion of Sir Humphry Davy, in 1809, and it has till lately obtained the confidence of most chemists, that *As soon as dung begins to decompose, it throws off its volatile parts, which are the most valuable and most efficient. Dung which has fermented, so as to become a mere soft cohesive mass, has generally lost from one-third to one-half of its most useful constituent elements, and that it may exert its full action upon the plant, and lose none of its nutritive powers, it should evidently be applied much sooner, and long before decomposition has arrived at its ultimate result.*' Experience has, nevertheless, acted in direct opposition to this opinion. Manure has been continually applied in 'a soft cohesive mass,' and it has continued to raise large crops; whereas, had it been applied 'long before decomposition had arrived at its ultimate result,' that result would probably have been a loss of crop, manure, and labour.

'It is certainly an erroneous assumption to say the first stage of fermentation in dung must necessarily throw off its most valuable parts. Every dunghill of fresh dung throws off a gaseous exhalation a very short time after it is put together; and the quantity thus thrown off is regulated by the state of the atmosphere. But this exhalation does not consist of the valuable gases; it is a mere evaporation of the water contained in the dung. The same hot haze may be seen flickering over a fallow field in a sunny day in summer. Nobody could with truth assert, that this haze arises from the disengagement of the gases in the dung which had previously been inserted into the soil, when it is clearly nothing more than the evaporation of the moisture in the soil. To say, therefore, the first stage of decomposition in a dunghill throws off "the most valuable and the most efficient" parts of the dung, is just to say the vapour of water is the most valuable part of dung.

'It is true, were the fermentation continued after all the water in the dung was evaporated, a considerable increase of temperature would ensue; and when the texture of the fibrous portions of the manure began to decompose, there would be an evolution of valuable gases. Direct experiment has proved the escape of gases from a heap of dung which has been long fermenting. But what harm accrues to the dung as a manure from the escape of these gases? None whatever. We are told these gases constitute the food of plants, and if they are permitted to be dissipated by decomposition, the quantity of nourishment in the heap of manure will of course be so much diminished; that if the bulk of the dung-heap be diminished one-half or one-third by excessive fermentation, the quantity of nourishment to the crops will be diminished in a greater ratio. These cautions have long been whispered in the ears of practical men, but they have listened to the advice with a provoking indifference. Like ducklings when they first take the water, they have continued to disregard every

* No. xxiii. pp. 617 to 624. The discoveries alluded to relate to a substance which chemists call *Humin*, which is said to exist in all soils, and to be formed of carbon and hydrogen. The *Humic acid* is composed of humin and oxygen, and its properties enable it to combine with lime, potass, ammonia, and many substances found in soils and manures, and renders them easy to be dissolved in water, which could not be done in their separate state.

remonstrance of their foster brethren against injurious practices, raising and devouring their food, and enjoying themselves with the greatest complacency in their vocation. It is true, and we must admit it, that some of the gases constitute the food of plants, but it does not follow that plants would receive them as food directly as they are disengaged from a fermenting and heated mass; nay, it is probable they would rather reject the food that would injure them. But as plants are not endowed with locomotive powers, they cannot avoid the food which is directly presented to them; they will therefore be obliged to partake of it even in an injurious state, and in thus taking it they die. Accordingly, we invariably find that plants suffer from the contact of fermenting dung; and it is this well-known fact, more than from any other circumstance, which deters farmers from applying dung in an unprepared state. It is sometimes applied to the soil, it is true, in an unprepared state, but long before the crop is brought into contact with it, and after it has undergone fermentation in the soil. Though this application of dung is recommended by men of science, it is performed from the very opposite principle which they recommend. They recommend it because the gases arising while the dung is fermenting are absorbed by the soil, and are thence given out for the use of plants; on the other hand, farmers perform it, because the fermentation will have ceased before the crop is inserted into the ground. Which of these is the more rational reason? The practical one, undoubtedly; for it is surely impossible that the slight covering of earth upon the dung can prevent the escape of the elastic gases, however it may retard fermentation.

'Moreover, practice finds that fresh dung is injurious to vegetation, and recent discoveries now inform us that this arises from the acridity of the ammonia, which is always present in unfermented dung. Fermentation drives off the acrid ammonia. Fresh dung is found to injure plants by *burning* them, which is a very appropriate term to describe the action of ammonia. In like manner, stale liquid manure is not so good a top-dressing to grass as fresh, or when it is largely mixed with water; because science now informs us, that ammonia becomes concentrated in stale liquid manure, and is therefore in an injurious state for plants; and that it is necessary to mix liquid manures largely with water, in order to dilute the ammonia, and allow the proper action of the humic acid, which exists in large quantity in them. Again, it is not an uncommon practice to cover a dunghill with earth in hot weather; and this is now explained, not as it hitherto has been—"that the earth absorbs and prevents the escape of the carbonic acid gas"—but that a violent fermentation in the dung is checked by the earth partly excluding the atmospheric air and rain water, the oxygen in either of which is indispensable to continue the process, it being this oxygen which forms the carbonic acid gas by uniting with the carbon of the dung. The necessity of checking a *violent* fermentation in a dunghill which contains a large portion of horse-dung, is to prevent it being what is technically called "*fyrefangit*,"—a state in which dung is nearly useless.

'We thus see that science now agrees with that practice which has been pursued for years with unexampled success. It is consolatory to practitioners to think that their experience, though unknowingly to them, has guided them to success on really scientific principles. This agreement of experience and science should teach every one that science *and* experience, and not science alone, ought to be made the tests to try the accuracy of opinions; but unfortunately for the credit of sciences, the test of accuracy hitherto, in the application of putrescent manures, has not been submitted to practice.'

We now not only beg to impress upon every farmer the absolute necessity

of guarding against the waste of any portion of the farm dung, but also to take care that nothing in the shape of refuse animal or vegetable substance be suffered to be thrown away by his servants. Let a bed of sand, or any earth except clay, be laid in some spot adjacent to the offices, and upon it let every particle of offal collected from the premises be regularly thrown; to which add the sweepings of the roads and lanes about the house, grass, turf, or rubbish dug out of drains and ditches; every thing, in short, which, by decomposition, can be converted into manure, and all of which may be got together with very little trouble. Let the whole of this be every now and then covered with the earth, between two layers of which a small quantity of quick-lime may be placed, or sprinkled upon any vegetable substance, such as leaves, tough haulm, fern, or any thing which cannot be easily dissolved, and thus formed into a compost. Care must however be taken that the vegetative powers of the roots and plants be completely destroyed before the compost is spread upon the land, for if unskilfully prepared, they will shoot up in the course of the ensuing season, and overrun the land with weeds. Composts thus formed, whatever may be the ingredients which they contain, will ever be found a most valuable species of manure. The whole substance becomes one uniform mass of nutritive matter, which may be either mixed with the soil, or applied as a top-dressing, and, with proper attention, may be got ready for application at any period of the year. There are numberless receipts scattered throughout the writings of various theorists, in which the quantity and the quality of each ingredient in these various mixtures are as accurately stated as if they were the medical prescriptions of physicians; but these are mere quackeries which do not merit the attention of practical men.

Weeds, also, by the sides of fences, should never be permitted to perfect their seeds, but should be invariably cut while in a state of succulence, and added to the heap; and if those turned up by the process of horse-hoeing were also raked off, instead of being suffered to wither on the land, or to spring up again with the next shower of rain, it is inconceivable what a large quantity of valuable manure might thus be raised by the occasional employment of children, and of labourers, who may otherwise be idling away their time. It would also contribute in a great degree to that neatness which forms a distinguished feature in careful cultivation, and would insure a habit of attention on the part of servants, and a consequent portion of prosperity which can rarely be enjoyed by a slovenly farmer.

Were the *practice of soiling* more generally attended to, it would also very materially aid the increase of the dung-heap, without which no profit can be gained from arable land. But a very small portion of the soil under the plough is, in this country, capable of bearing crops, unless it be recruited by putrescent manure about once in four years, or that it be either suffered to lie for a more than usual length of time under the cultivated grasses and fed off with cattle or supported by the fold. To obtain the requisite quantity of farm-yard manure has, however, baffled the best exertions of many industrious farmers, except in the immediate vicinity of large towns. There, indeed, the object is often obtained through the means of purchased dung, the expense of which has been generally amply repaid by the growth of proportionably increased crops; but any one who is dependent upon the produce of his own farm, without the assistance of extraneous manure, for the support of the fertility of the soil, should endeavour to cultivate those crops which are best calculated to afford a large return of food for the maintenance of cattle. When the land is of such a nature as not to admit the

growth of green crops, hay and oil-cake should be resorted to for that purpose.

In other cases, *lime*, *chalk*, *marl*, and various other *mineral substances*, have been resorted to as auxiliaries; but the effect of some of these tending more to stimulate vegetation than to enrich the wasted powers of the soil, it has frequently happened that ground which at one time had been greatly benefited by their application, has afterwards been injured when repeated under the erroneous notion that its powers might be restored by the same operation. Land, thus forced, has in many cases been so much impoverished as to render it incapable of producing any thing but a poor pasture, and to require a great length of time to pass away before it can be restored to its original condition. It should, indeed, be observed, that the application of fossil manures requires more judgment and consideration than any other; for vegetable and animal manures contain the fertilizing property within themselves, and, however injudiciously applied, cannot fail to impart ultimate benefit to the land, if not to the immediate crop; but the power of fossils consists in their action upon the constitution of the soil, and if this be improperly directed, the greatest mischief may ensue.

None of these has, perhaps, produced more injury in some cases, or greater benefit in others, than lime—of which very striking instances may be found in those parts of the country where it is either very abundant or scarce. In the former it has been not uncommonly laid upon the land without the aid of putrescent manure, until the soil has become worthless; while in the latter, as its scarcity renders it expensive, it has only been moderately used by farmers of judgment and capital, and the effects, after a number of years, are still apparent in the improvement of the soil. While writing this, we have under our eye a farm of 400 acres of strong clay, which has not been limed within the memory of man. The tenant, who is conscious of the advantages which might be derived from the use of lime—as demonstrated in the condition of adjoining land of the same quality—is yet prevented by circumstances from its employment; and thus, not only are his own profits, but the value of the soil to the landlord also, equally reduced.

On the subject of *burnt clay*, we have recently had an opportunity of making some inquiries in the neighbourhood of the late General Beatson's farm, in Sussex; and we have learned, that although several practical farmers in that part of the country adopted his plan, yet very few of them have found it to answer their expectations. One of them, who has followed it extensively, confirms us in the opinion which we have already stated, that much depends upon the mode in which the operation of burning is performed; for if the clay be calcined to the consistence of brick, it yields nothing in the shape of that soft ash which is proper for manure; and if not sufficiently burned, it will return to its original condition. In the former state it may, however, act in some degree as an alterative of the soil; and in the latter, it will at least afford some nutriment to the crop to which it is actually applied. It therefore does not appear, from past experience, that it can ever be made to supersede the use of lime on land which has not been formerly dressed with the latter; but in such cases, or in parts of the country where lime cannot be procured, it may yet be employed to a certain extent with advantage.

As to *paring and burning*, there can be no doubt that the earth, if combined with fibrous roots and other vegetable matter, will answer the purpose of manure when burned; yet shallow soils are thus frequently more injured by the abstraction of too large a portion of the surface, than improved by

the temporary addition of the manure. We have lately seen down-land, which was broken up during the war, and has been now during several years returned to pasture, yet still bears nothing like the sward of a fine sheep-walk on the poorest chalks, and probably will require half a century to bring it back to its former condition. We therefore cannot but again caution all farmers and owners of land against bringing such soils under the plough *. *See* " Clay Soils," in Supplement.

With regard to *gypsum and salt* we have notning to add, except to repeat our recommendation of experiments on their effects†. Though quite aware of the common sentiment—'that gentlemen may use their superfluous cash for this purpose, but farmers have uses enough for their money in the regular routine of their business, and few are so over-burdened with capital as to afford the risk of its diminution by uncertain speculation'—yet we entreat them to reflect, that experiments may be tried with those two articles upon a single acre; that the expense, if unsuccessful, can only occasion the loss of a few shillings; but if they succeed, may be productive of incalculable advantage.

Neither respecting the various *miscellaneous substances* which we have enumerated have we any further observation to make upon their respective properties. The fluid or dissolved parts of animal matter require some preparatory process to fit them for manure, the great object being to blend them with the soil in a proper state of minute division; for when they have been applied in a rank or unreduced state, bad effects have followed. *Train-oil, blubber,* and similar refuse, should therefore be made into composts with a large body of earth ‡. *Rape* and *malt dust,* requiring no mixture, are very commonly laid upon the land as top-dressings—the difference between which and manure ploughed into the ground, is, that the former are applied chiefly with a view to the sole benefit of the immediate crop, without regard to the further improvement of the soil; though there can be no doubt that if the crop be increased, the soil will also feel their good effects. In this manner *soot* is also almost invariably used; but its fertilizing properties are solely referable to the ammonia contained in it, which is an active stimulant of vegetation. The practice of laying it upon land which has been limed, or of mixing it, as sometimes done, in composts with lime, is therefore injudicious §.

It has long been a disputed question, whether all plants extract the same nutritive juices from the soil, and convert them into the kind of sap adapted to their peculiar qualities, or whether each is nourished by a different substance. It would at first appear improbable that plants differing from each other in form, smell, taste, and properties as food, should be produced by the same matter; yet, when we reflect that different plants deprive each other of nourishment, by extending their roots into the same soil in which various kinds are planted, we cannot but conclude that their first nutriment must be of the same nature, though the sap

* A treatise has been just published by Professor Rennie, on Paring and Burning, in which he attributes whatever value it may have to the effects of the fire, considering it ' in the light of an instantaneous fallow.' Were this principle to be relied upon, it would follow that paring and burning might, within a few years afterwards, be advantageously repeated; whereas experience proves that, with whatever benefit the operation may be attended in the first instance, a repetition of it is always found to impoverish the soil.—See the Quart. Journ. of Agric., No. XXV.

† See Chapters xiv. and xviii.

‡ ' Tallow and oils received in a crude state by the roots may clog the pores of the plant, repel the aqueous fluid, and obstruct the free communication of the leaves with the atmosphere.'—Sir H. Davy's Lect. on Agric. Chem., 4to. p. 112.

§ Hornby on Lime, p. 26.

probably acquires different properties in its progress towards perfection. This, however, is one of the secrets of vegetation with which we are unacquainted; but as we also see that some soils are better adapted than others for the growth of particular kinds of grain and vegetables, and that those crops to which they appear the most favourable yet become deteriorated if repeated, even though regularly dressed with one species of manure, it seems evident that there must be some advantage in the change of manures, as well as in the system of cropping tillage land*. This will be gained by every farmer who has at his command manures of an unusual kind, and who understands their use, for he may then adopt many plans of cropping which are out of the power of others not similarly situated, and vary his rotations according to circumstances of the moment, or to his own convenience.

We have already touched upon the properties of alkaline manures, so far as they have been tested by experience: the solution of the effects of acids upon the soil must be still left to future experiments, for those already made by chemists, in many instances, present different results. Whatever may be the food of plants—whether gases, oils, salts, or acids—the farmer, however, need not puzzle himself about their chemical qualities, for he may either satisfy himself from the experience of others, or by small trials of his own, whether the effects of any particular species produce fertility or not. Farm-yard manure has been justly called 'the farmer's magic wand;' and the oftener that wand is waved, the more will it contribute to his prosperity. He sees that wherever it has been judiciously used, it causes abundant crops, and that wherever it has been withheld, sterility seizes upon the soil: his chief efforts should therefore be directed to its increase.

Although the time and manner of applying every description of manures depend so much upon the nature of the soil and season, as well as of the crops to be sown, that no precise rules can be laid down for their employment yet the following general hints may be found useful.

SUMMARY.

When manures of any kind are to be used as top-dressings for grass, the best season for that purpose is as early as practicable in the month of February, as the vernal showers will then wash them into the soil. If for arable land, at the same time as the sowing of the seed, or immediately after; but if for wheat, when vegetation is about to acquire force in the spring.

If dung be applied to a wheat crop, it should be ploughed in during the course of a summer fallow; if compost, at the last ploughing before the seed furrow; but composts of lime and earth only may be laid upon the land during any period of the year.

The land should be laid dry; and the manure should be equally and speedily spread over every part of it, in proportion to the nature of the soil; but if ploughed in, though it should be well mixed with the ground, it should not be too deeply buried.

The stronger and the colder soils are, the more manure they require; and, as such land is generally applied to the production of crops which do not speedily attain their full growth, the application of dung which has not been completely decomposed by the putrefactive process may be there admitted; for although the progress of vegetation may not be so rapidly

* Sir H. Davy, Agric. Chem. 4to. p. 273. Doncaster Report on Bone Manure p. 27 See also the recent 'Theory of the Rotation of Crops,' by M. De Candolle.

forwarded, yet the manure will at length decay, and afford a more gradual degree of nutriment to the present, and greater support to the land for the production of future crops. On adhesive land, long manure from the farm-yard also acting mechanically, by keeping the soil open, is not so binding as short dung; but on dry, sandy, hot soils, the dung should, on the contrary, be perfectly decomposed, or rotten; and manure of any description should, on such land, be only laid on in moderate quantities at one time. One general observation may be made regarding all dissertations on manure, which is—that as there will be different gradations both of soils and the substance of which manures are composed, we can never speak but in general terms of their application.

The following table will explain how many heaps of manure—each containing an equal quantity of any given amount—are required to dress any field, per acre, at certain regular distances: so that, by calculating the solid contents of the manure in cubical yards, each containing 27 bushels, and dividing it by the number of heaps, the exact quantity to be laid on in each heap may be correctly ascertained:—

No. of heaps, at	5 yards distance	. . .	193 per acre.
„	5½ „	. . .	160 „
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„	8 „	. . .	75 „

Chapter XXVII.

SOILS.

Imperfect as was the knowledge of husbandry in former times, yet our forefathers were enabled to distinguish the qualities of the soil with great accuracy; for those parts which were the most anciently cultivated, and which formed the infield land around their villages, are found at the present day to consist of the best ground when in its natural state, though much of that which has been since broken up has been greatly improved by the application of manures, and the progress of successful cultivation.

The difference in quality of the fruits of the earth—more particularly remarkable in grain—though distinguished in many places by the names of the districts in which the corn is grown, yet does not arise from any other cause than dissimilitude of soil and climate; and the utmost exertions of cultivation can only to a certain degree improve, but never effect, any absolute change in the indigenous nature of its productions. This, indeed, is generally admitted, so far as regards soils; but although they may be apparently of the same kind, yet their fertility is materially affected by climate, notwithstanding they may be situated in nearly the same part of the country, and with little variation of level; for although the heat indicated by the thermometer may correspond, yet the temperature of the air is varied according to the aspect of the land—whether exposed to the north or south, and the prevailing winds occasioned by the position of adjacent highlands and vales—and the seasons are thus rendered earlier or later. The natural situation of a farm—independently of its local connexion with roads and markets—is therefore an object of the first importance, and affects its value much more than is commonly supposed; for the estima-

probably acquires different properties in its progress towards perfection. This, however, is one of the secrets of vegetation with which we are unacquainted; but as we also see that some soils are better adapted than others for the growth of particular kinds of grain and vegetables, and that those crops to which they appear the most favourable yet become deteriorated if repeated, even though regularly dressed with one species of manure, it seems evident that there must be some advantage in the change of manures, as well as in the system of cropping tillage land*. This will be gained by every farmer who has at his command manures of an unusual kind, and who understands their use, for he may then adopt many plans of cropping which are out of the power of others not similarly situated, and vary his rotations according to circumstances of the moment, or to his own convenience.

We have already touched upon the properties of alkaline manures, so far as they have been tested by experience: the solution of the effects of acids upon the soil must be still left to future experiments, for those already made by chemists, in many instances, present different results. Whatever may be the food of plants—whether gases, oils, salts, or acids—the farmer, however, need not puzzle himself about their chemical qualities, for he may either satisfy himself from the experience of others, or by small trials of his own, whether the effects of any particular species produce fertility or not. Farm-yard manure has been justly called 'the farmer's magic wand;' and the oftener that wand is waved, the more will it contribute to his prosperity. He sees that wherever it has been judiciously used, it causes abundant crops, and that wherever it has been withheld, sterility seizes upon the soil: his chief efforts should therefore be directed to its increase.

Although the time and manner of applying every description of manures depend so much upon the nature of the soil and season, as well as of the crops to be sown, that no precise rules can be laid down for their employment yet the following general hints may be found useful.

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tion of all the vegetable products of this country depend, with very few exceptions, upon the degree of heat which they enjoy during their growth; and it is well known that when the soil is dry, and the harvest early, corn of the same weight yields more saccharine matter than that which is produced under less favourable circumstances*.

No two farms can indeed be found precisely situated, in point of soil, situation, climate, and exposure, and a very small difference in any of these circumstances will occasion a great diversity in their fertility; consequently no rules can be strictly applied to their management. It has, however, been justly observed, 'that farms thus variously soiled are spurs to ingenuity—obliging their occupiers to break through those confined opinions and narrow prejudices which are too frequently contracted in countries where a uniformity of soil and regular routine of management prevail†.' See "Soils," in Supplement.

From the vague manner in which soils are frequently described, and the various acceptation of the same terms in different counties, it is difficult for a farmer who reads an account of the agriculture in any other district than that in which he resides, to judge what relation such a soil may bear to that which he himself occupies. In some parts of England, any loose clay is called marl, and in others it is called loam; while this is defined by one to be a fat earth; and by another, a mixture of clay, sand, and calcareous earth, without stating the proportions. Regarding the latter, it has indeed been remarked by the late Mr. G. Sinclair, that, on referring to books on husbandry and gardening, we are directed to a hazel loam, a brown loam, clayey loam, or to a humid sandy soil, peat earth, garden mould, &c.; but the want of proper definitions of those terms is so perplexing, that it is really impracticable to determine what kind of soil is meant: thus, of upwards of fifty different kinds of soil and composts examined by him in various parts of the kingdom, those under the same name were found to differ greatly in their respective qualities. The method of determining the nature of soils by chemical analysis has, however, been of late years so much simplified by Sir Humphry Davy, that it is now in the power of every practical person to ascertain their properties, without much risk of being mistaken‡.

* This has been clearly established by the application of the *saccharometer*—an instrument invented for the use of maltsters, brewers, and distillers, for the purpose of ascertaining the strength and value of worts. The common standard by which the value of grain, of apparently equal quality, is usually estimated, is that of the weight in proportion to its cubical measure; and when the corn is to be manufactured into meal, this must ever be a primary object, though subject to many deductions, which also enter into the consideration of the miller. But among those who require it for the purpose of brewing, the saccharometer is a more certain criterion—as, whatever the weight of the grain may be, its strength, or nutritive power, will be in proportion to the quantity of saccharine matter which it contains.

† Marshall's Rural Econ. of Yorkshire, 2nd edit., vol. i. p. 281.

‡ All soils contain sands of various degrees of fineness, and impalpable earthy matter; when, therefore, the exact proportions in which these are combined in a soil are ascertained, it shows directly to what class it belongs—whether the loamy, clayey, calcareous, sandy, peaty, &c. Sir H. Davy, however, states, in his Agricultural Chemistry, 'that the term *sandy* should never be applied to any soil that does not contain at least seven-eighths of sand. Sandy soils that effervesce with acids should be distinguished by the name of *calcareous sandy soil*, to note the difference which exists between them and those that are silicious. The term *clayey* should not be applied to any land that contains less than one-sixth of impalpable earthy matter, not considerably effervescing with acids. The term *loam* should be limited to soils containing at least one-third of impalpable earthy matter; and a soil to be considered as *peaty* ought to contain at least one-half of vegetable matter. These may be considered as the genuine characters of soils, and determined by a very simple process—that of washing the impalpable earthy matter of

COMPOSITION OF SOILS.

The surface of the earth is composed of various descriptions of matter, chiefly minerals—viz., clay, lime, marl, gyps, fluor, talc, sandstone, slate, quartz, and barytes. These are the names by which geologists distinguish the different kinds of rock (whether in solid masses or pulverized) which compose the superstratum, and which, when reduced to an incoherent mass, forms the soil, or what we call the arable staple of land.

In order to convey clear ideas of the components of arable soils, brief notices of the different earths may, in the first place, be given—in order to lead to a right understanding of how one kind of soil is more fertile than another, and also how any one may be improved by admixture with another.

Clay is an earth consisting of several varieties, differing in colour, tenacity, and some other particulars. Blue clay is found in immense beds under the channel of rivers, in the bottom of valleys, or forming the superstratum of hills over chalk or limestone. Almost every kind of clay contains qualities favourable to vegetation: more especially those varieties which are decomposable by the action of frost, or the alternate effects of showers and sunshine. A surface of pure clay requires to be long under cultivation before it becomes favourable for the operations of husbandry; but when thoroughly reclaimed, no description of soil yields more abundant crops. *See* "Soils," in Supplement.

Calx is lime combined with acids. To this description of earth, chalk, powder-chalk, and all the different sorts of marble, belong. The two former are found in vast masses forming some of our highest hills on the south of England. They no where constitute the arable surface, except on the margins of the hills formed of them; but are discoverable, in a reduced or powdery state, in almost all our best soils. A portion of lime earth is an useful addition to all soils, particularly clays and dried gravel. Being attractive of moisture, it assists the effect of frost on clay, and gives consistence and coolness to light land in summer.

Marl is calcareous, or lime earth, mixed with clay. The common marl has a soft unctuous feel, and is found in thin strata, or in beds of considerable thickness, in various parts of the kingdom. A marl-pit of this description is a valuable source of riches to the light-land farmer: a good coat of it bestowed on a sandy or gravelly field effects the greatest improvement—not only by giving consistence to the staple, but also adding a fresh accession of vegetable food; and that called shell-marl acts powerfully upon the improvement of clays.

Gyps is calcareous earth saturated with vitriolic acid. This peculiar earth is found in a loose state at Glipston Quarry, in Northamptonshire, and in several places on the continent. In its solid forms it receives the names of alabaster, plaster-stone, or selenites. Being heated, it falls to a fine powder, which, when mixed with water, forms plaster. Gypsum has been highly extolled as a manure, particularly for grass land: yet its use, as we have already seen, has not been generally persisted in; but there can be no doubt that it acts as a powerful stimulant to vegetation, and probably future experience may induce its more frequent employment.

These are a few of the names given to the different earths found on the surface of our globe. In beholding their individual structure and stratified appearance, we cannot be otherwise than convinced that even the hardest

the soil from the sandy portion, and by drying and ascertaining their respective weights—when the application of an acid shows whether it belongs to the calcareous or the silicious kind of soil.'—Sinclair, Hort Gram. Woburn., p. 118.

were once in a state of fusion; and that the various strata have been, at greater or lesser intervals of time, superposed on each other by the mighty agents of nature. According to their situation or composite character, these strata are denominated *first*, *second*, or *third* formations. Of these other deposites are formed, called *shifted formations*—because they have been removed from a first to a second place. In these transitions, fire, as well as water, has been active; as its effects in the disruption, transformation, and elevation of parts of the various strata sufficiently evince.

But it is to that grand convulsion of nature, the flood, and to many local and partial inundations which have since taken place, that the present habitable face of the earth has received its peculiar character as to the undulations, consistence, and qualities of its varied surface; for whether the land emerged from the deep, or was only overflowed for a time, the *effects on its surface by the subsiding waters would be the same.* Hence we see that the most ponderous and solid accumulations resisted the current, and the loose and lightest were removed to a distance: the different deposites taking place according to their specific gravities, or the strength of the current which bore them along. Of these different earths, deposited as we find them at the present day, the foregoing are the principal. The cultivable surface, or soil, is compounded of dissolved portions of these different earths in various degrees of commixture, each possessing different properties and qualities, more or less favourable to the growth and sustentation of plants; and this according to the quantity of decomposed vegetable or animal matter they may contain. As they differ in constitutional composition, and as they are variously affected by the changes of weather, so also do they require different culture, as remains to be shown.

CLAYS.

From the brief description already given of this soil, it will appear that it is impervious to, and retentive of, water; and therefore the laying it as dry as possible is the first and only practicable means of improvement. A clayey surface is generally undulating and declivous, consequently favourable for the operations of the drainer. Diagonal, or gently winding furrows, or underground drains, carry off water much more steadily and effectually than if laid in direct or precipitous channels, because there is less hazard of the current being so impetuous as to disturb the retaining sides, or block up by drift the openings of the drains, or course of the furrows. Hence we see in old husbandry the propriety of, or the reason for, laying the lands or ridges in such tortuous or winding directions, and withal so much gathered in the middle. By this disposition of the surface, water is effectually, though slowly discharged; and the whole laid and kept dry*. In laying the surface in due form, the plough is the only efficient implement; but where local circumstances oppose the completion by the plough alone, the spade must be employed. Deep ditches are

* It must however be admitted, that great loss and inconvenience arise from this ancient mode. In undulating countries the lands are decidedly the best to be as nearly flat as the formation of the furrows will admit—and in low districts, the fall for the water is reduced in equal ratio with the raising of the ridges. This robs the furrows of their due portion of soil—keeps them so full of moisture as to prevent their being made, or kept, free from weeds and aquatic grasses—and renders all the operations of the husbandman more troublesome to perform. On sheep-farms these hollow furrows ought never to be seen, as the loss occasioned by the death of sheep from getting "*over-laid*" in them, would amply repay the expense of levelling them, without burying the better soil. For the mode of executing this work, see Reports of Select Farms, No. V. Scoreby, Pp. 13, 14 in the Farmer's Series of the Library of Useful Knowledge.

always necessary in a clayey country; for the soil imbibing but little of hasty showers, heavy rain, or melting snow, outlets should be numerous as well as capacious. Before undertaking an expensive design of underground draining, the depth of the surface stratum of clay should be ascertained; because, if it reposes on a bed of gravel, chalk, or stone, the surface water may be got rid of with but little trouble. Openings made through the clay in places where surface water naturally settles, will probably allow all excess to sink.

It is hardly necessary to allude to the great advantages arising from the perfect drainage of a clay soil: it gives firmness to the surface, thereby facilitating all the operations of cultivation; it adds an extra warmth to the air above it; matures the crops earlier, and more perfectly; and renders all trespassing of cattle or carriages less injurious.

The next most important aim of the cultivator of clay land is to counteract the natural tendency of it to *run together*. This can only be done by deep ploughing, and incorporating with the staple any kind of friable earth—such as sand, chalk, marl, and manures of all kinds. These, besides enriching the land, keep it more porous, and consequently more penetrable by all atmospheric influences. The deeper the staple the more fertile it is and also more manageable on all occasions. Any excess of rain received upon the surface sinks away therefrom to the bottom of the staple, or arable superstratum; and though it may be upheld by the undisturbed pan, it oozes imperceptibly away over it to the lower end of the slope.

Much attention is required with regard to the time, or rather to the state, of a clay soil, which is about to be ploughed. If too dry, it breaks up in unmanageable clods very difficult to be reduced to the requisite fineness for sowing; and if too wet, it lies sodden in whole furrows, poached into holes by the feet of cattle, and altogether unreducible by the harrows. The due temperament is when the clods can be crushed without kneading under the foot or roller. In this state it may be got in order for any crop with the common implements.

The general character of clay farms is, that though the crops are abundant, they are cultivated at great annual expense. Great strength of teams and implements, and much tear and wear occur, in consequence of the more frequent need of fallows. When a heavy soil becomes foul with root weeds, there is no remedy like fallowing; its stubborn adhesiveness does not allow of freeing it from weeds by any other means than by repeated ploughing and exposure to a summer's sun. While the weeds are destroyed, the soil is ameliorated; and in autumn is fit to receive a dressing of manure followed by wheat seed. If pretty free from weeds, it may receive what is called a winter fallow—*i. e.*, ploughed in the autumn—lie all winter to be reduced by the frost—and in the spring it will be in order to have seed sowed upon it as soon as it is dry enough to be harrowed. Some such clay soils are regularly fallowed every third year, which is certainly a great loss to the tenant, when not duly provided for by the terms on which he holds his land, and indeed, in all cases, to the community; but there appears no remedy—at least, no profitable remedy. For notwithstanding machines have been invented, and much ingenuity exercised, to break and loosen the hardened surface of clay soils for the reception of seed, yet, though a passable crop might follow this breaking or rubbing (as it may be called) of the surface, it was soon found that the deep-rooting perennial weeds were neither checked nor destroyed: so that the practice was soon abandoned. There is, however, some descriptions of heavy land where no fallowing is required. Wheat and beans, or other corn, and clover

succeed each other alternately, and the weeds which are nurtured by the wheat are kept under by the hoe during the growth of the beans. An opposite description of heavy land is called hungry clay: this is commonly mixed with gravel, impregnated with a considerable portion of iron ore. Very few plants enjoy themselves on this kind of soil, and it is only improvable by thorough draining, liberal dressings of lime or chalk, and frequent dunging. In the neighbourhood of chalk hills this kind of land is often met with, and is much improved by a coat of pure chalk;—to obtain which, pits are sunk in the fields down to the rock, whence the chalk is drawn in the manner detailed in Ch. XII. In all those countries where chalk abounds, the fields are indented with circular hollows, showing where the rock has been excavated below; and from the very many large dells to be seen in the same districts, now filled with fine old oak trees, it is evident that chalk—either as it is naturally found, or after being burnt into lime—was in very early times extensively used for improving the surface of the land.

Clay is improved by chalk, in consequence of the latter breaking the consistency of the former. If drawn and laid on in the autumn, the frost will reduce the lumps during winter, so that it may be ploughed in at seed-time, or when the field is fallowed up. The pulverizing or reducing effect of chalk on clay is occasioned, as before mentioned, by its power of attracting, at all times, a large portion of water from the earth or air; and this being congealed by frost, swells and disturbs every particle near it. Its mechanical reduction of clay facilitates all operations, and renders it in every respect fitter for the growth of plants. When chalk is burned and slaked by water, or in the air, before being laid on land, its effects are an immediate and powerful stimulant to vegetation, besides freeing the land from slugs and insects. *See* "Clay Soils," in Supplement.

CALX OR LIME.

It has already been observed, that chalk, though one of the primitive earths, is never, in a pure state, found forming an arable surface. It is, nevertheless, present perhaps in all good soils; and, from what has been remarked of its properties above, it should be the endeavour of the farmer to make use of it as much as possible;—though in saying this, it must be of course understood that it is to be employed with a due regard to prudence. It is equally beneficial to clay, sand, gravel, and peat-earthy soils; and though not, perhaps, the direct food of plants, is a prime agent in preparing vegetable or animal matter already on the soil to yield nutrition to all. *See* "Lime," in Supplement.

Caustic lime is supposed to be a preventive against that disease in wheat commonly called smut; not only in preparing wheat seed, but by dressing the land with it before sowing. Whether it be a cure for this disease is, perhaps, questionable, because we know it is not in every instance effectual; but we are quite sure that the wheat crop will be greatly improved by such a dressing. Clover leys, intended for wheat, are much infested by slugs, which often, if not prevented, prove ruinous to the crop. In such a case, a liberal cast of quick-lime should be given before the plough, which will either kill or so disable the slugs, that no danger need be apprehended from their depredations. If the lime be not given before sowing, it may be applied after the wheat is up if necessary. It may either be sowed by hand from seed-kits, or from a light cart with shovels. Night sowing, when the dew is on the blade, is most effectual; because the slugs are then feeding. If rain fall soon after the lime is sown, its burning quality is lost, and no longer offensive to the slugs; in which case, another dose will be necessary.

Of the other descriptions of earths, there are only two combinations of them which are particularly interesting to farmers, viz., sand and loam.

SAND AND GRAVEL.

SAND, if dry, is easier and less expensively cultivated than any other. Though very subject to be infested by quetch and other running rooted weeds, it is readily cleared of them. The crops raised on sand are sooner ripe and some descriptions are of finer quality than those from richer and stronger ground; but the bulk is deficient in both corn and straw. The liability of sandy land to suffer from drought is a great drawback on the profits of cultivation. In dry summers, the crops are sometimes hardly worth collecting. At the same time, no land pays better for improvement, provided the means are at hand and the force sufficient. Whatever application has a tendency to give it compactness, will also make it more retentive of moisture. For this purpose, clay, marl, chalk, or any other earth of a heavier description, will greatly improve the staple. For sheep husbandry, a sandy soil is well adapted; the treading and tail dress of the flock is invaluable for such land. *See* "Sandy Soils," in Supplement.

Whatever has been observed relative to sand, is equally applicable to *gravels* and all other light land liable to suffer from drought.

Like sands, they possess various gradations of quality, from almost absolute barrenness to great fertility. The former are in general termed *hungry soils*, from their tendency to absorb manure without any corresponding benefit to the land; but as their staple becomes firmer by the admixture of other earth, so do their properties improve. The richer kinds produce every species of grain, and though the looseness of their texture renders them less suited to the cultivation of beans and wheat, yet they are admirably adapted to that of Lent corn. The quality of the grain is likewise good; and being also favourable to the growth of leguminous crops and artificial grasses, they are commonly called *turnip soils*, from that root being generally cultivated on such land. It may be worked as arable land in any season, and is sound enough in grass to bear stock in winter.

Sometimes clay and gravel lie in alternate strata, *cropping out* * on the sides of hills. This is one of the worst descriptions of arable land, in consequence of the great number of land-springs flowing out of it; difficulty of drainage, and its liability (in consequence of stones and clay being so firmly bound together) to become impenetrable by the plough after a dry time. It is in this species of land, too, that we often find both the gravel and clay tinged with the oxide of iron, than which nothing is more injurious to corn crops.

There is another kind of land, very widely spread throughout our southern counties, which, though not properly of a gravelly nature, yet is so intermixed with loose stones of a moderate size, as to bear some resemblance to soils of that description. The staple, indeed, is more commonly of clay than sand, and the stones are chiefly *flints;* which may be justly supposed to affect the quality of the earth with which they are mingled, by imparting to it something of their calcareous nature, for the land in which they are found is very generally fertile. There is in Yorkshire a singular species of it, called red-stone land, which is composed of loams of different qualities, intermixed with a greater or less quantity of soft sandy stones, about the ordinary size of flints, and of a dark yellow or orange colour; a species of grit or freestone. The cultivated soil is, in some instances, nearly half of

* A term used by miners to signify the highest edge of the bed of coal, &c., or where it appears on the surface.

loose and porous, quickly saturated with water, and too easily discharged from it. See "Pearl Ashes," in Supplement.

A late writer on the subject remarks, "that when we consider the vast extent of the masses of this bog, which, in the cold and temperate regions, overspread so great a portion of the surface of the earth, and which, though full of vegetable matter, is yet little friendly to vegetable life, we may believe that in its history, in its nature, and in its uses, it presents many materials to the agriculturist for inquiry, which may illustrate the means of either converting it into a soil or into manure, for the improvement of other lands: but it must be confessed that these important inquiries have not all been so perfectly answered as is to be desired; and that much yet remains to be learned of the nature and the uses of peat-moss*."

It only remains to be noticed that there are two other constituents of soils, namely, *salts* and *metals*, and which, where they abound, have a powerful effect on plants. Of the latter, iron is the most frequent, and, when in excess, is prejudicial, especially to corn crops. The ores of other metals, as ead and copper, are also hurtful to vegetation; but this only appears in the lnear neighbourhood of mines.

Of salts, there are many descriptions found in land springs, and usually recommended for medical purposes. Their existence in arable land is, however, imperceptible, unless very near salt springs. Sea, or common mineral salt, though not a food of plants, is, notwithstanding, a useful ingredient, particularly in dry soils. Its great affinity for water assists summer crops wonderfully. It is also an excellent cleanser and renovator of exhausted soils. Slugs will not live where it is in any sensible quantity; and while it is grateful to cultivated plants, it appears to be offensive to moss and all diminutive weeds. Its use as a dress is too much neglected by farmers.

There is thus an endless variety in soils, and those of apparently equal fertility are almost all differently composed. A certain knowledge of chemistry is necessary to ascertain in what those differences consist; for it is in the accuracy with which they are described that the best modes of remedying their defects, and improving them by the application of either lime, clay, sand, or other fossil substances, can be discovered. Farmers, however, generally contrive to obtain a tolerably correct notion of their imperfections by a comparison with the soils of their neighbours, and thus experience in such cases supplies the want of science. The sure indications of a good soil are commonly to be found in the state of the hedges and timber, especially oak and ash—full, wide-spreading tops presenting an appearance of luxuriant growth; whereas, if stunted, it is a certain sign that the land is poor. The weeds, natural to peculiar soils, are also strong proofs of either poverty or fertility. Land is, in certain cases, also to be distrusted, although the crops upon it may be fine; for they may have been forced by over manuring, and thus brought to a condition which it may be found very difficult to continue: while, on the contrary, good land, though exhausted by improper cropping, may be easily restored by judicious management.

Few soils are so ungrateful as not to pay the expense of improvement, provided the money laid out upon them be applied with judgment. Many tracts of the poorest sand have been rendered fertile by judicious dressings of clay, loam, or marl, and other thin and hungry soils have been improved by the application of similar substances; while those of the sourest description have had their acidity corrected by lime, chalk, and ashes. It should, however, be borne in mind, that land, of any description, which is retentive of water, can never be rendered fit for the plough until it has been

* Mr. Low, on the Classification of Soils, Quart. Jour. of Agri., N. S., vol. i. p. 30.

completely drained; for, otherwise, the operations of tillage cannot be accomplished in due season. Its state will have a direct and prejudicial effect upon its productive powers; and manures can never communicate their full benefit to any soil which rests upon a wet bottom.

Chapter XXVIII.

OF EMBANKING AND DRAINING.

In order that the surface of the earth should be in a fit state for the successful culture of every useful plant sowed or planted thereon, it is above all other circumstances necessary that it be free from superfluous moisture. The surface is liable to be too wet from various causes, viz., floods, tides, land and main springs, or from its local or constitutional liability to retain water which falls from the clouds. From whichever of these causes a field or a farm is deteriorated, the remedies are either by embankments or by drainage.

Floods, it is hardly necessary to observe, are caused by heavy and incessant rain, or a deep snow suddenly melted. The rivers swell and overflow their banks, and much damage ensues. The water thrown out of its natural channel remains in hollows from whence there is no outlet; and the herbage or crop which it covers suffers till it is drained or evaporated off. All countries are more or less subject to floods; more especially those whose surface is undulating, and soil composed of fine loam or clay. Such soils do not readily absorb water—it running off rather than sinking into the ground. The contrary is the case on light, sandy, or gravelly land, which drinks up rain almost as fast as it falls, and consequently is less subject to injury from floods.

EMBANKING OF RIVERS.

In districts where a sluggish river winds its way through a wide extent of level meadow, confining the former to its own channels is often a work of great difficulty and expense. It can only be accomplished by making the river an aqueduct between raised banks; and when this is the case, machinery is necessary to raise the back-water over the unnaturally raised banks. This, however, has been successfully done in many places in the fens of England; and is always a commendable undertaking when tho advantage to be gained is commensurate with or exceeds the expense.

There are many situations where judiciously-formed embankments would be of infinite service, and which may be executed at a moderate charge,—often by only widening the channel, and raising the banks with the excavated earth. In flood-times those places where the water first flows over the banks should be marked and raised; especially those outlets nearest the head of the stream. Repairing and raising the low places in the banks of a river liable to overflow should be a never-to-be-forgotten part of a superintendent's duty who has the charge of contiguous lands. Raising the banks may be executed at once, either by deepening the shallows or widening the channel to obtain earth for the purpose; or such raising may be done at different times as convenience allows. The material of the bank should be of an uniform solid consistence, such as puldded clay or loam

assumes when dry. No decomposable vegetable or mineral should be employed; the mass must be impervious to water; both back and front should have a good slope, the latter covered with a turf of aquatic grasses, with flags at the base, to prevent the bank being undermined by the current. Constant inspection is necessary in preserving river banks; the least slip or breach should be instantly repaired; a hole made by a mole or water-rat may lead to much damage, and consequent expense. Clearing the river of weeds, bushes, shoals, or other obstructions, often prevents an overflow; and where a river is not a boundary of two properties, removing promontories which jet out into the stream is a good plan to facilitate the course of the current.

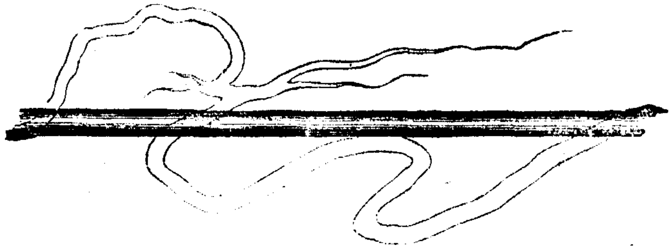
On rivers of magnitude it is of course absolutely necessary to employ an engineer to construct the embankment; but small brooks are also very subject to overflow their bounds in rainy weather, thus occasioning considerable damage to the neighbouring land, which, however, may be in a great degree guarded against by the properly-directed efforts of the farmers through whose grounds they run. Where mills occur, and the fall of the water does not exceed six feet in a mile, the dams that are erected across for the purpose of securing a supply, are also in many cases productive of great injury to the adjacent fields; and there are even many instances where the mills have not only a dam for throwing the water into the main sluice, but also other dams farther up the river for collecting the water in dry weather, thus completely preventing the drainage of the surrounding country.

When these shallow streams take a winding course, if the proprietors can agree among each other to straighten them, that object can be generally effected with moderate expense, and their encroachments be thus permanently prevented; but when different estates are bordered by the same stream, insurmountable objections are often raised regarding the limits of the new boundary. The cutting of the new channel however requires but little ingenuity, and is attended with no other difficulty than mere manual labour, which may be easily calculated by the size of the intended canal, and the nature of the soil to be cut through; and although the stuff taken out of the new channel may not be quite sufficient, after raising its banks, to fill up the old water-course, it yet will in most instances go far to effect it, for the new cut should always be made of a good width. It has, indeed, been justly remarked by an eminent water-drainer, who has lately written on the subject, that "one great mistake which is often connected in the straightening of water-courses is, in not giving the new channel sufficient dimensions, whereby the water is forced over its banks into its former course; and in not giving the sides sufficient slope, whereby the banks are undermined."*

To give particular directions for forming the slopes, depends on the kind of land through which the stream is to pass; but it has been usually found that from one and a half to two feet on each side, for every foot in depth, is sufficient: the greater the slope, however, the better. The passage for the water should be made as smooth as possible, in order to prevent the accumulation of rubbish; and a covering of sound turf—especially if it has been taken from a place abounding with rushes, rib-grass, or other aquatic plants, and gets time to grow and become firm before the floods come on—is the best protection to the bank. Every precaution should, however,

* "The Practical Irrigator and Drainer, by George Stephens." Edit. 1834, p. 125. A work in a small compass, but containing numerous plans, and much information on the subjects of which it treats; from which we have obtained some valuable hints.

be taken to secure it; and, if the work be of magnitude, the better plan may be to contract with some responsible person for its execution, and to bind him to uphold it during a certain number of years. Some idea of the quantity of land which may, in many similar cases, be saved from injury, at a moderate cost, by thus straightening the course of otherwise insignificant streamlets, may be formed from the annexed sketch, actually taken from the survey of a farm in the county of Kent, fifty-six acres of which were reduced to a state of coarse marsh, until thus confined within a new channel: the cut was 671 yards long; the whole expense, including that of strengthening the embankment with a foundation of stones at the entrance of the old course into the new cut, amounted to 74*l.* 14*s.*, and the land is now sound meadow.



Land may be also reclaimed by embankment on small bays or arms of the sea, in situations where the shore is very shallow; and, where deposits of matter have been thrown up which are capable of forming a rich alluvial soil, much valuable ground has been thus gained. There are also many other parts of the United Kingdom in which capital might be employed for the same purpose with great advantage; but this being a subject exclusively appertaining to the interests of landlords, we do not deem it sufficiently applicable to those of the whole of the farming community to fill a place in our pages.

DRAINAGE OF LAND.

Land may be nearly useless for the purposes of the arable farmer, by reason of *land-springs*. Such springs abound where a gradually-descending surface is formed of alternating strata of sand and clay, or gravel and clay; and which strata crop out at different distances on the slope. The porous beds readily admit rain or melted snow-water to sink; but it is upheld by the beds of clay, and there accumulating forms subterranean reservoirs, whence it is ever trickling over the edges of the clay strata down the slope to the lowest ground.

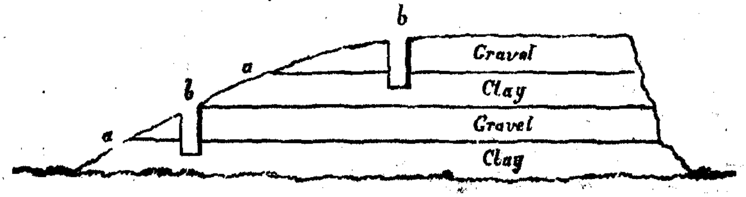
In order to lay this description of land dry, the drainer should in the first place endeavour to gain a good idea of the different strata, the dip or inclination of their surfaces, together with their respective thickness. It was on this description of wet land that the late Mr. Elkington gained so much credit and profit to himself, and satisfaction to his employers*. He per-

* He is generally supposed to have been the inventor of the system alluded to; but this is disputed by Dr. Anderson, in his "Practical Treatise on draining Bogs and swampy Grounds." Nor is his system to be implicitly trusted; for, although it has succeeded in most instances, yet in others, under his own management, it has occasioned great expense, and has been attended with complete failure. See the "Sussex Report," pp. 191—197; and the "Survey of Devon," p. 309.

ceived that, as the water was upheld near the surface by the sunken beds of clay, perforating those beds by a long iron dibber or fold-pitcher allowed the water to sink into the next bed of loose earth beneath, and so got rid of it at a very small expense. In many cases it might happen that he would have the same thing to do on the next shelf of clay lower down; but, by going over the whole field on the principle of opening diagonal drains above the issues of the springs, he cut off the source, and either let it down by piercing the bed of clay, or led it away by a gentle fall into the nearest ditch. These leading *under-ground drains* might be opened to the depth of two or three feet, and wide enough for the digger to work with freedom; and afterwards filled up with stones or coarse gravel to within one foot of the surface, in order to be ever after out of the way of the ploughshare.

As land subject to such springs is usually very varied in its surface, the water oozing out in many different places, it cannot be laid dry by one or two drains. Many short drains may be required; and in fixing the places and directions of these drains, one circumstance should always guide the drainer, viz., wherever dry and wet portions of the surface are seen near together, the improver may be convinced, without examination, that clay lies beneath the wet, and sand or gravel below the dry, portions. The remedy in this case is by opening a drain above the wet place, deep enough to collect and cut off the source, and lead it to the dry ground, where it will naturally sink. Even a pond which is of no use for cattle or other purpose, and from which there is no natural outlet, may be got rid of by sinking a shaft into the nearest bank of gravel or chalk, and making a covered duct of tiles or bricks to carry the water from one to the other. This manœuvre is called forming a swilly, or swallow, and is very effective in many places where there is no natural hollow by which, at a moderate expense, the pond may be dried.

It is often seen, on such descriptions of springy land, that the more elevated parts are gravel reposing on clay, and the base of the hill is rich, loamy soil, fit for every purpose of the farmer, were it not too moist. This rich soil is not naturally wet—no springs rising therein; but always too moist, from water soaking imperceptibly from above. To improve this lower division of the surface, it should be separated from the upper by a deep open ditch, or a capacious covered drain. This in all likelihood will keep the more valuable portion dry; and by shallower drains made higher up, and ranging parallel with the first, the whole slope may be effectually drained. Here may be observed what are general rules in draining—viz., that the place of the drain should always be *above* where the water oozes out; and the direction or fall never too precipitous. Thus in the following section of a wet hanging field—water upheld by the strata of clay oozes out at *a*, *a*; consequently, if drains be made at *b*, *b*, the springs cannot appear on the surface.



The first rule enables the drainer to catch the water before it rises to injure the surface; the second secures the efficiency of the drain for ever, or for at least many years. When a drain is made directly downhill (a custom too common among unpractised hands), an impetuous current is generated, carrying with it particles of earth, which are here and there obstructed. Invisible dams are thus formed, the drain becomes choked up, and the work must be done over again. But when the drain is laid with an easy fall, even though it may increase its length, the water percolates away gradually and constantly, forming no obstruction of settlings; consequently, the drain answers the purpose for which it was made, and the improver is not disappointed. From all this it appears that the professional or practical drainer should be somewhat of a geologist—that is, he should be acquainted with the stratification of the surface, the properties of the different strata, their extent, thickness, inclination, &c. He should be able to judge on the instant, whither, if stagnant water were at liberty, it would trend; as well as what are the causes of its presence in any one spot more than another. A knowledge of these circumstances are necessary in the art of draining; and, without such knowledge, much time may be lost and money expended to no purpose. Designing the drains requires much more address than the mere execution of them: if the first be right, the second can hardly be done wrongly—provided due attention be given in the choice of, and disposal of, the materials employed.

Land-Springs are liable to be dried up in summer; and this circumstance often reconciles those who suffer from them to bear with their injurious effects in the spring. But this is only a kind of indolent economy, because it often happens that the ploughing or sowing of a field is delayed because the land-spring is not dried up. Whether they are constant or temporary, they should be diverted under the surface by one means or other; as no mode of cultivation, or pains bestowed, can be successful on springy land.

Main-Springs may overflow the surface of land; but this is seldom the case, because wherever a main-spring rises, it generally flows away in a channel formed by itself; and if this course be kept open, it can be no annoyance. The difference between main and land springs is chiefly this: the former rise from a great depth, often from below all the stratums of rock, chalk, clay, or other earths forming or near the surface of the ground. The water is warmer, soft, and much purer than that of land-springs; and, unlike the latter, never impregnated with any mineral quality. The vein in which main-springs exist is sometimes reached by the common well-digger, but it is more expeditiously and less expensively found by boring. For the different purposes of a farm-house (indeed for every house), main-spring water is invaluable. For the kitchen, and brewhouse, and particularly for the dairy, it should always be had if within convenient reach. Even for the cattle it would be desirable; and decidedly better than the rank and muddy chalybeates which fill many horse-ponds.

Having noticed how land may be rendered nearly useless to the owner, by reason of its liability to be flooded by rivers, tides, and springs, we have next to notice how it may be worthless from a redundance of water arising from its retentiveness of that element, owing to its contexture, or *dead level* position of its surface.

Some of the richest land in the kingdom is formed of *alluvial deposites* in the bottom of valleys. Its consistence is so extremely fine and compact, that water is very slowly imbibed by it: hence in a wet time, or even after a heavy shower, the turf becomes like a sponge; and the surface having little

or no declination, the water rests longer upon it than is suitable for the grass, for the cattle that feed upon it, or for those who breathe the vapours rising from it. Add to this that, when in this sloppy state, heavy cattle poach it sadly—breaking the turf, and filling it with steppings and holes, which become so many pools of unwholesome water. If sheep are put on such land in autumn, it will go far to rot them; in a showery time, it is with difficulty hay can be made upon it; and many other inconveniences attend the possession of such a description of land, unless it is thoroughly drained.

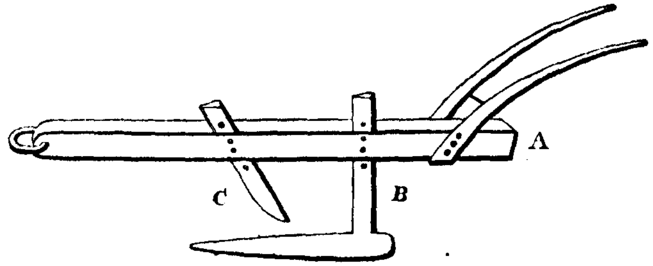
But *how is a dead level to be drained?* This, indeed, is no easy affair, although it is done in many places with very good effects. The surface may have a fall, whether perceptible or not: when this is ascertained, a large receiving ditch is opened at the bottom; and if the meadow be o considerable length, two or three other receiving ditches are opened a different distances higher up. These being first finished, surface drains, from six to twelve feet apart, are made from the top to the lower end of each division. These may be called *catch drains*, and are thus made. The drain being lined off a foot wide, and the turf at each side cut through with a racer, turves are cut off four inches thick, and of any the most convenient length, and laid regularly on one side to be replaced when the bottom of the drain is completed. This done, a narrow trench is dug out of the centre of the naked space with a spade, and a channel is made from end to end. After this, a still narrower pointed tool is used to make the cleft or channel another spit deep. A shoulder is thus left on each side of the cleft, on which the sod that was first taken up is carefully laid with the grass side downwards, and the remaining space is filled up with the loose earth, as represented in the following cut at fig. 1.

Open drains on grass land will also carry off much of the surface water, and lay the land tolerably dry without turning up much of the soil, as they need not be made deep. A common plough may indeed be so held, if neatly made, with an iron mould board attached to it by means of rivets, about nine inches high, and formed with a slight curve, as to throw over a sod of about six inches wide, by which means it will cut the ground in small triangular trenches, nearly like those at fig. 2, the sides of which may then be firmly pressed down, and afterwards kept clean by a cart-wheel with the addition to the felly, as designed at *a* in fig. No. 3. The felly is that of a six-inch cart-wheel, with an addition of wood, of a conical shape, to put on round the felly, and either to be shod with iron, or a rim of solid iron to be added to it.

A wheel of this description put on the axle of a cart in the common way, will, of course, rest on the rim of iron; and on driving the horses forward it will fit exactly, if so made, into the trench, and thus press it down

in every part equally. That side of the cart must, however, be loaded with some heavy material, in order to make the wheel sink into the soil; but as the wheel on the opposite end of the axle will only support the empty side of the cart, it will not cut the land. If the soil require very close drainage, a pair of wheels may be fitted with such rims, and being fixed upon an axle projecting beyond the cart to the intended width of the trenches, will perform the operation still more completely. The advantage of this contrivance is, that it not only makes a firm indent in the soil sufficient to carry off the water during the winter, but in the following spring these drains will be so nearly clothed with grass, that little or nothing will be taken either from the pasturage or from the scythe; and in this manner the drains may be kept clear at the approach of every winter, at such moderate expense that a man with a couple of horses may go over from ten to twenty acres, according to the breadth of the drains apart from each other, in the course of the day*. There is, however, one objection to all kinds of open drains in pasture land—that, when fed with sheep, they frequently occasion them to be cast; and therefore, unless narrowly watched, they may become dangerous to that stock.

There is, therefore, another mode of preventing injury to meadow ground with *under drains*, by the use of the *mole-plough*, here represented, which

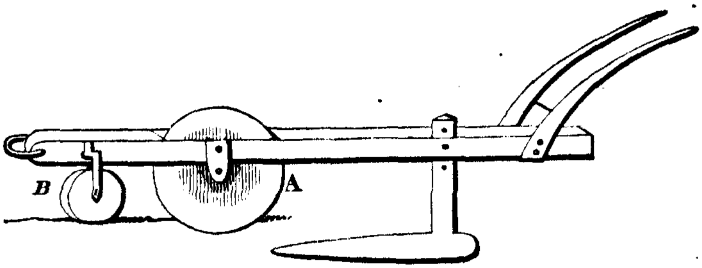


consists of a strong beam, A, with stilts of the usual form. The mole, or borer, is a well-tempered cast-iron conical share, of about three inches diameter at the largest end, but sharp at the point, and supported by a very stout flat wrought-iron bar, B, mortised into the beam, and about an inch in thickness at the back, but champered to a sharp edge at the front, to cut the soil. The coulter, C, is rather smaller, but cuts with the edge in the same line, and in some ploughs has been also made a support to the mole by being fixed into it; but the plough, with a coulter of that construction, does not clear itself of obstructions so easily as when left with the usual space between, as in that above designed. It works in general at about a foot underground, but the depth may be regulated by pins placed through the beam in the coulter and support of the plough; and in a clayey soil of sufficient adhesiveness to prevent the crumbling of the earth, it forms a close hollow space, as round and compact as a leaden pipe †. The sides, however, become so perfectly closed as to completely prevent the filtration of water, and would therefore only serve as a passage to convey a quantity from any point of the meadow to a large drain, or pond, were it not that the cut made by the coulter and support through the upper part of the soil leaves a small opening, which has in some cases been partially filled up immediately under the sward with plaited straw, which prevents the sides from closing, yet

* See Middleton's Survey of Middlesex, 2nd edit. p. 360.
† Ibid. p. 361.

allows of the grass to grow over the cut, so as to avoid all appearance of the operation.

In using this plough it is, however, necessary to guide it very evenly, or the drain will not carry off the water; and it has been thus found advisable to make it with wheels to the fore end, as in common ploughs, by which the depth of the draught may be regulated. The beam with the mole and its support are thus formed as in the plough already described; but, instead of the coulter, an improvement has been made by forming an iron cutting wheel, A, sharp at its circumference, but gradually increasing to an inch in thickness at its centre: it is about 18 inches in diameter, and revolves in the mortise of the beam, but its pivot or axis is moveable, so that it may be placed either higher or lower, as may be found necessary. Under the muzzle of the beam there is a roller of wood, B, about six inches in diameter, reaching across the beam, and working upon an axis sustained by cranks bolted to its sides.

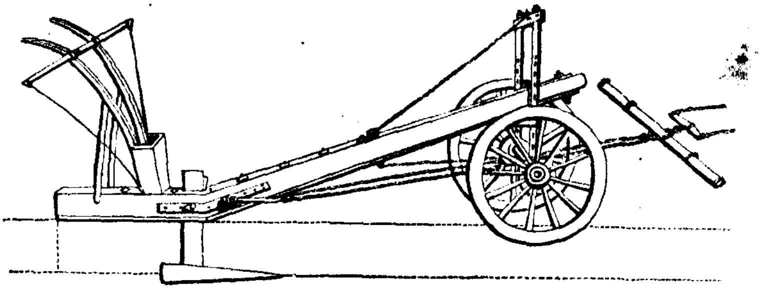


This implement has been found to perform its work more correctly than the other; but either of them requires so powerful a team, that nothing short of six or eight, and in some soils ten, horses can move them. This occasions such considerable expense, that in some instances the expedient has been resorted to of erecting a windlass at one extremity of the drain intended to be cut; having one end of a rope attached to it, and the other end to the bridle of the plough, which is placed at the other extremity, and being impelled either by men, or by a single horse, moving round its axis at about 15 feet distance, acts with sufficient power to effect the operation with such ease, that an indifferent horse has been thus enabled to drain from 2½ to 4 acres of stiff clay within his day's work. In order to secure the windlass from being moved by its own action towards the plough, it is firmly fixed into the ground by claws set in a stout frame, which being also upon wheels, can be moved to another part of the field, when the process of the cut has been accomplished *.

There is also a mole-plough, which has been used with great success in Essex. The mode in which it is employed is, first to draw a furrow with a common plough, and then to apply the mole, drawn by 15 or 18 horses, three abreast, carrying the drain to the depth of from 14 or 18 inches. The reason of employing this great strength is to avoid the trampling and poaching of the soil, as it is never used when the surface is wet. In some places, indeed, it is used with a five-horse whipple-tree, working 20 horses, five abreast; but the drain is then carried to the depth of 22 inches. Drains thus effected have been

* See Williamson's Agricultural Mechanism, p. 230.

found to last in perfect condition during several years; and some men have thus drained as much as 250 acres. Thirteen acres have been drained in two days; and the method is said to be in the end cheaper than the common mode with the spade *. It is, however, a ponderous and expensive instrument, as may be perceived in the annexed cut.



As water flows but slowly on a level surface, these drains can only be quickly serviceable to a little distance on each side of them; but as what is received by them will be followed by some of that at a greater distance, a diminution of the whole will ensue, and will be productive of so much good to the land. From these last observations, it is also perfectly obvious, that the nearer together these catch drains are, the more effectual will they be.

But in order to make such a tract of meadow as productive as possible, and to facilitate the drainage of it afterwards, it should be broken up and laid into proper form by the plough. We are aware that the old-fashioned conditions between landlords and tenants are peremptorily against breaking up old meadow or pasture land. But where no check of this kind intervenes, the best thing that could be done with dead-level land of this description is to break it up, and after taking two or three white crops, laying it in well-rounded ridges, and sowing again with the permanent meadow grasses: an immediate profit would thus accrue to pay all extra expense, and leave the surface in such a form as would render draining afterwards an easy matter; as the furrows would not only mark the places for the drains, but render them effective for drying the surface †.

These are the plans which are commonly executed to improve meadow or pasture land subject to surface water; but land of a more porous character, or that has any thing like a sensible fall, facilitates every expedient of drainage. Stone drains along the lowest places, and in a porous soil at considerable distances apart, and carried to a free outlet, would carry off superfluous water, or prevent injurious stagnation.

Draining a dead-level meadow is, however, like draining a moss. The former retains water for a long time equally diffused on the surface: the latter holds it suspended in its fibrous texture. Numerous small drains, to invite a flow of water, are more effectual than very large open ones at greater distances. When a large open ditch is cut through a flow moss, it is quickly filled up again, because the moss itself flows with the water; and

* Survey of Essex, vol. ii. p. 200.

† We allow this remark to stand, as being the opinion of a very experienced person, to whom we are indebted for the greater part of this, and some other articles in the work; but, unless under very peculiar circumstances, we hold to the objections against the breaking of old meadow or pasture.

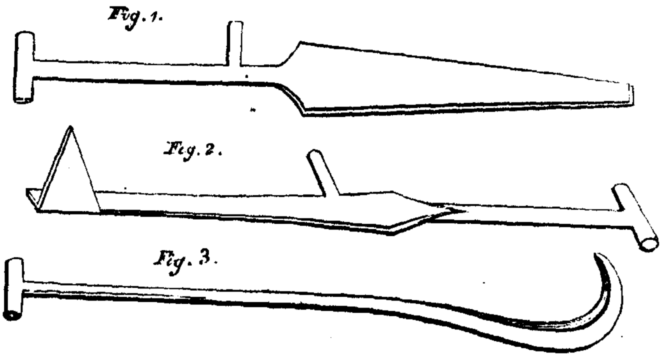
though in the case of a level meadow of fine tenacious soil, there may be no fear of the sides of ditches slipping in, if properly made, yet the operation of such ditches, as before observed, is too confined to do much good. It follows, therefore, that the surface should be first divided into compartments by open ditches, and these compartments subdivided by hollow drains four or five yards apart. The open ditches should be four feet wide at top, and somewhat more than a foot at bottom.

Wet sandy land is of all others the most difficult to be laid dry; because the whole subsoil is in a state of fusion, commonly called quicksand. No sooner is an opening made than it is almost instantly filled by the falling in of the sides. No kind of fencing of lasting material can keep back the sand and permit the water to escape. The whole valley, where such soils are met with, appears to be a lake filled with pure sand, rising two or three feet above the surface of the water. The turf formed thereon is tough and capable of carrying light carriages and animals; but nothing but aquatic trees and herbs can prosper on such a soil. Land, so saturated with water, could not exist if there were any natural outlet; and therefore there is no letting it off but by sinking a shaft on the nearest spot of firm ground down to the first stratum of porous earth or chalk, into which the water from the wet land may be turned. The expense of such an expedient, it is true, must be incurred before its efficiency can be proved; but there is no other mode of proceeding.

Arable land of fine quality—and however hilly—if the pan or subsoil be so compact as not readily to admit rain, sometimes requires *hollow draining.* This is a simple process: a hollow is made by turning out two furrows, right and left, by the plough; this is deepened by wedge-shaped tools, filled with straw or stubble, and again covered up. These drains last for ten or twelve years.

There are various modes employed for their execution. If the land be apparently flat, the only certain method of ascertaining which way the water drains is by means of the instrument known as the spirit-level. The declivity can however be generally discovered by the eye, but it is an object which must be particularly attended to, for if the drains be carried in a wrong direction, they will become blown or burst, and thus occasion considerable injury; especial care should therefore be taken that their bottoms are made with a regular descent, so that the water may run from one end to the other without standing dead. They should also be laid aslant the ridges; for if parallel to the furrows, they are subject to damage by the treading of the cattle in the operations of tillage. Care should likewise be taken to make as many of them as possible empty themselves separately into the main drain or ditch, without crossing each other, for thus any stoppage in either of them can be readily ascertained. They should especially be cut so near to each other, and so deep, as to ensure the perfect drainage of the soil; for any partial operation will prove of little benefit, and the expense will be nearly thrown away. Their distance must therefore vary according to the quantity of water to be got rid of, and no regular scale can be given. If the soil be very tenacious, the drains will not act effectually at greater distances than from 18 to 30 feet; but if it be sandy, they may be placed much farther apart, for there are many situations in which one deep drain will do more good, and be executed at much less expense, than a number of shallow ones. In short, the great errors in the common systems of draining consist in the want of due discrimination in the soil adapted to their use, and in the false economy too generally employed in their imperfect construction.

The most common method of proceeding is as follows. The intended track of the drain being fixed, a line is stretched upon pegs along its course in a perfectly straight direction, and the plough goes turn up and down, making a clean and deep furrow which forms its outline; that part which the horses could not reach in turning being dug out with a common spade. The draining tools are then had recourse to, which usually consist of well-tempered implements, one about 4 to 5 inches wide at top, 2 to 3 at bottom, and 12 or 14 in length in the blade,—the other, 3 inches wide at the top,—from 1 to 1½ or 2 inches at the bottom, and 15 in length; of the form of fig. 1. A grafting iron—not generally used—with a side-bit of about 4 inches by 6, as at fig. 2; and hoes, resembling scoops, with a crane neck a foot long, of the smallest width of the former, fixed into a long handle, as at fig. 3.



The drainer then begins by taking out a spit in depth with the largest spade, which he follows with the smaller tool; and the scoop is used to clear out any loose mould which may remain in the trench. These different operations leave the drain in the shape of a wedge, about 30 inches deep, from 10 to 12 inches wide at the top, and from 1½ to about 2 inches wide at the bottom; for the narrowness of the bottom adds strength and durability to the drain. It is then filled up to the height of 8 or 10 inches, either with brushwood, stripped of the leaves—oak, ash, or willow twigs being the best—and covered with long wheat straw, twisted into bands, which are put in with the hand, and afterwards forced down with the spade, care being taken that none of the loose mould is allowed to go along with them. The trench is then entirely filled up with earth, the first layer of which is closely trampled down, and the remainder thrown in loosely. It should also be filled up and closed immediately, to prevent all chance of the sides breaking in; and the operation should never be undertaken in frosty weather.

Such is the plan usually adopted in Essex, Suffolk, Norfolk, and most of our midland counties; but there can be no doubt that, in many cases, the soil may require the drains to be deeper, and that the best mode of filling them is with *stones*, which will both last longer and be more efficient. The drains must in that case, however, be of larger dimensions, and filled up to the height of full 18 inches*, which will necessarily render them more ex-

* Mr. Stephens, in his Treatise on Draining, recommends that in porous soils with an impervious bottom, they should be about 4 feet deep, at least 12 inches wide at the bottom, and filled up to within 12 inches of the surface. When the depth does not exceed 5 feet, 2 feet wide at top will be sufficient; but whenever it is more, the width

pensive. Care should also be, as far as possible, taken to select those stones which are of moderate size, and as smooth as may be; for if broken very rough, they are apt to collect the impurities of the water and to become choked: large pebbles or coarse gravel, if to be had, are the best, but they should be freed from any earth that may adhere to them before being used, and they should be laid along the side of the drain before the commencement of the operation of cutting. They should also be covered with sand; as clay, being impervious, will prevent the drainage.

The mode of *draining with tiles* has been clearly explained in the reports of select farms already published in the Farmer's Series of the Library of Useful Knowledge*. It is an increasing practice, and extremely useful in those districts where stones do not abound so much as to be applied for that purpose. The tile is from 13 to 14 inches in length, something more than 4 inches in width at the bottom, and 4½ inches in height. The arched channel to admit the passage of the water is 3 inches wide at the bottom, and 4 inches deep. The drains are cut so narrow that they only just receive the tile, and not deeper than is necessary to secure them from injury on the surface, and to ensure a regular descent to the outlet. This is best ascertained by executing the work in the winter season, or early in the spring, when the excess of moisture points out the direction for the drains, and the water proves the truth of the level. So soon as the tiles are laid, a little straw or coarse grass is put over them, to prevent the loose mould getting into the interstices between tile and tile, and choking up the drain; for though they are placed so close as to touch each other, there is always sufficient space for the water to insinuate itself between them on the top and sides, as well as to rise through the bottom; and thus they collect the water as freely as the "*rumbling drain*" of stones; and if the soil be not remarkably retentive of moisture, it is rendered sufficiently dry by drains twelve yards apart.

The charge for the labour of tile draining, when the tiles are purchased from the manufacturers, varies, like every thing else in different places and circumstances, but the average of all expenses may be assumed as—

		s.	d.		s.	d.	
With 3-inch tiles	at	1	0	to	1	2	per rood of 21 feet.
— 4-inch ditto		1	3	to	1	6	
— 6-inch ditto		1	4	to	1	8	

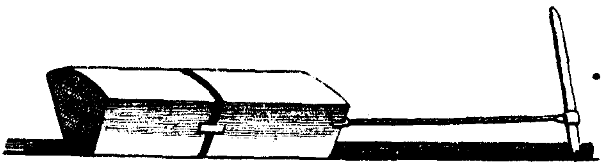
About 1000 tiles are in this way required for an acre of land, which cost on the average 2*l.* at the maker's yard; the expenses of loading and labour are estimated at 1*l.* 5*s.* to 1*l.* 10*s.*; thus the whole expense is calculated to be about 3*l.* to 3*l.* 10*s.* per acre.

The cost of *stone-draining* has been effected in some instances so low as 4*l.*, and in others, with every gradation of expense, up to 13*l.*; but in most cases it amounts to from 5*l.* to 7*l.* per acre. Where there is a great body of water to be collected and conveyed, an opening, three feet wide and of equal depth, is thrown out. In the bottom, a flooring of plain tiles is laid across: on the ends of these, building bricks are laid on edge, and covered with building bricks laid in bed. On each side, and above this brick-work, irregular stones are filled in, and up to within one foot of the surface. This is a most efficient drain to carry as well as to collect water, and lasts for many years.

should be increased 4 inches for every foot in depth, and the width at the bottom should be 20 inches, which will give sufficient space for a substantial conduit.—p. 109.

* See No. II, containing those of Kyle, in Ayrshire; and Netherby, in Cumberland: in the last of which there is a minute detail of the mode of manufacture, and the expense of the various kinds of draining tiles. Also that of Scoreby, in the East Riding of Yorkshire, No. V.

There is another method of forming hollow drains, in some countries called "*wedge*," or "*plug draining*," and which answers on clay soils. An opening to the desired depth is first excavated, one or more pieces of wood, six or eight inches in diameter, either of a round shape, or of the same form as the bottom part of the common drain, and joined together by links to any convenient length, are laid in the bottom, and covered up by earth tightly rammed upon it. This done, the first plug is withdrawn by a staple and plug fixed in the lower end by a lever purchase. Another length of the ring is next covered, and drawn forward; and so continuing to the end: thus—



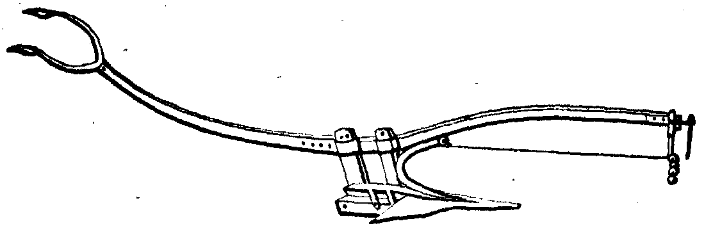
In this manner the plug forms an arch; but care must be taken to prevent the entrance of vermin, by gratings placed across the mouths of the outlets; and these cross drains should not be carried into the main drain at right angles, but should be turned a little aslant a short space before they reach it, in the direction which the water is intended to take, by which means any accumulation of mud at their mouths will be prevented—a precaution which, if neglected, may occasion their stoppage. If the operation of ramming that portion of the clay which is laid over the wedge be carefully performed by a stout workman, drains thus constructed have been found to last for many years in perfect security. They possess also the great advantage of being constructed by mere manual labour, without any expense for materials or cartage, and at cost so comparatively moderate, that we learn from a gentleman who has had them executed in Gloucestershire, within the last four years, to the extent of more than 300 miles, that the whole charge does not, in ordinary cases, amount to 1¼*d.* per yard*. That for digging only is, in some places, for 2 to 2½ feet deep, 6*d.* to 8*d.* per rod of 18 feet; increasing, of course, according to the depth and other dimensions†.

There is also a plough, as designed in the next page, invented by Mr. Smith of Deanston, which has been found useful in stirring and breaking up a tenacious subsoil, and when employed in conjunction with parallel drains, distant at spaces not exceeding twenty feet from each other, materially assists the drainage of the land. It is of comparatively easy draught; follows the common plough; and working to the depth of ten or twelve inches lower, thus penetrates the ground to the depth of sixteen to eighteen inches; but, having no mould-board, it only stirs the subsoil, without

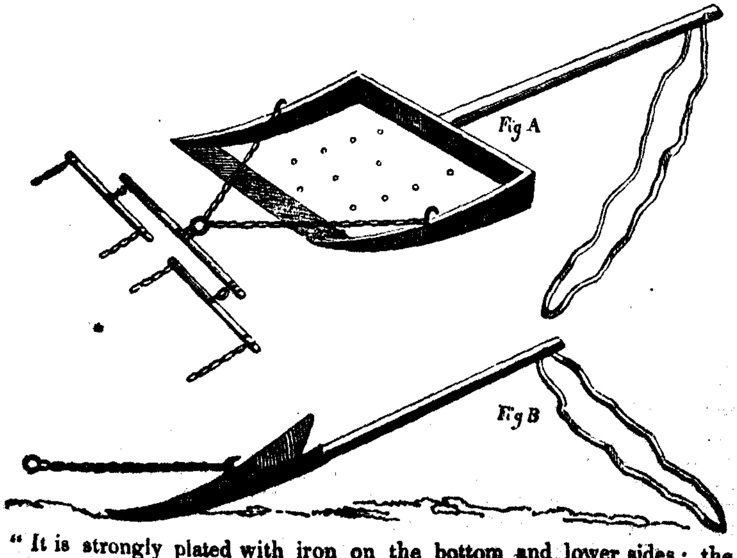
* See the very minute account published by W. S. Evans, Esq., of Selkirk House, Cheltenham, in the Quart. Jour. of Agric., No. 22, p. 501; and also that of Mr. Osborne in the Papers of the Bath and West of England Society, vol. xv., p. 67, who states, that he has thus drained more than 30,000 rods within the last seven years, and has so much improved his farm, that where green crops formerly rotted in the ground, he now feeds 800 sheep on turnips throughout the winter. His plan was, however, to form the drains by the close ramming of clods of clay, without the use of the plug; which appears to expose the drain to unnecessary hazard, and not to be attended with any saving of expense.

† Mr. Drew states, in his Norfolk Husbandry, that he has had them cut at 2½*d.* to 3*d.* per rod; but that was when the drain had been opened to half its depth by two deep furrows having been ploughed.—p. 160.

bringing it to the surface; and when drawn by four horses, in pairs abreast, will plough about an acre a day*.



An account is given in Radcliff's Agriculture of East and West Flanders, of a mode of draining practised in that country upon a very wet and strong soil, which has been attended with such advantages that we think it merits attention. "It consists chiefly in dividing the fields by furrows of three feet wide into different sets, or compartments, of sixty feet wide each, and dressing these from the sides to the centre, or crown, in a raised and rounded form, so that the rain water should run off, and be conducted to the boundaries of the field, and from thence to a sufficient fall at the extreme enclosure of the farm. The elevation of the centre is about two feet above the level of the extreme sides of the sets respectively; and particular care is taken to lower the head ridges, so as to remove all impediment to the running off of the water from all parts of the field. This *operation, as well as that of dressing up the earth from the sides to the* centre of the broad-sets is executed by means of a simple but useful implement called the *mouldebaert*, which resembles a large square malt-shovel, about 3½ feet square, as delineated at foot, in the perspective view at fig. A, and the side view at fig. B.



"It is strongly plated with iron on the bottom and lower sides; the handle is fixed into an iron socket, and it is drawn by a pair of horses with

* This plough may be had of Robert Robertson, smith, at Drip, by Stirling. The cost, with swingle trees, and chains for drawing, is 9*l.*

swingle trees. The driver, who has long reins, by pressing moderately on the handle as the horses go forward, collects and transports five cwt. of earth to the place where it is to be deposited, which is effected in the most summary manner, by letting go the handle. This causes the front, or edge of the machine to dip, and catch against the ground, whereby it is at once inverted and emptied of its load. The extremity of the handle, to which a rope is affixed, by this inversion strikes against and rests upon the swingle tree bar, and in this manner the mouldebaert is drawn along towards the accumulated earth, when, by taking up the rope, the driver draws back the handle, collects the load as before, proceeds to the spot which is to receive it, and the horses are never for a moment delayed."

We have inserted the description of this instrument, because we agree with the writer that—if it acts as described—it must occasion a considerable saving of time and labour; that on wet soils it has a superiority over the wheeled cart; and that it might also be advantageously employed in carrying manure from the head-ridges, as well as in many cases of levelling; but we must confess that the manner in which the load is delivered does not appear to be clearly explained.

SUMMARY

The *subdivision of a farm into fields* should always be done with a view to the drainage. The ditches may be so contrived as to act not only as ducts but as drains, and much wet land might be laid dry by judiciously-planned fences. The wet should always be separated from the dry land, as the place and depth of the ditch may thus often lay both dry.

Much of the business of common draining may be designed by the farmer himself, and executed by his own labourers; but if such improvement be on a considerable scale, and on different descriptions of land, the advice of a professional drainer should first be taken.

Spring and autumn are the most convenient seasons for laying off drains, because it is then easier to see where they are required than during summer; but they may be constructed at any period of the year.

If the land be of a decidedly retentive character, the drains must then, however, be placed so close, that in whatever manner they may be constructed, they will rarely be found to repay the expense; but, in such soils, if the ridges and furrows be properly formed, the latter sufficiently deep, with a regular descent, and kept so accurately clean as to prevent the accumulation of stagnant puddles between the ridges—this attention, combined with deep ploughing, will prevent the water from standing dead; and the necessity of a more regular drainage may be avoided.

One decisive objection which exists in a great extent to the expense of drainage, arises from the reluctance evinced by many landed proprietors to grant leases to their tenants; who, unless possessed of that security for the fair return of their outlay, or of a corresponding confidence in their landlords, cannot be expected to expend their capital in permanent improvements upon the land. The interests of landlord and tenant are so intimately interwoven, that no misunderstanding should be allowed to prevail, and the former should assist the latter, to any reasonable extent, in effecting a perfect system of drainage, rather than compel him to the temporary and inefficient expedients to which he is sometimes induced to resort, to the inevitable loss of both; for its full advantage can only be gained by having it done well. There is no improvement to which the heavy soils of this country owe so much as to its introduction; and the increase of fertility which it has occasioned is not more important at the present day, than, if followed

up with spirit, it must prove in its consequences hereafter. Of the vast addition which has been thus made to the income of many estates, numberless instances upon a large scale could be adduced; but it is sufficient to cite the splendid example of the late Duke of Sutherland, whose large property in Shropshire and some parts of Staffordshire has, by the liberal assistance afforded to his Grace's tenantry, been brought from a state of almost waste to form one of the best-cultivated districts in the United Kingdom *.

Chapter XXIX.

WASTE LAND—MOORS—FENS—WARPING.

MOORS.

The plan of inclosing commons, which was carried to such great extent during the late war, has now, in consequence of the fall in the prices of agricultural produce and the losses sustained by those who became purchasers of the land †, been so far abandoned, that we only deem it necessary to advert briefly to that subject. The propriety of a general inclosure has been warmly advocated by political economists, upon grounds of national advantage, which, whether just or not—if its effects upon the moral condition of the peasantry be considered—it is not our present business to inquire; though it is doubtful whether the indiscriminate inclosure of commons has been in any instance of that benefit to the nation which has been generally supposed, for many of them certainly could never pay the expense of obtaining the act—of the commissioners' fees—of the construction of the fences —and of bringing the land into cultivation: in this respect it has, therefore, been a dead loss of capital to the country ‡. Were the improvement of some of the large tracts of moors belonging to the Crown, which now only yield a scanty support to an inferior race of sheep, undertaken by Government, there can, indeed, be no doubt that it would afford employment to a large number of the labouring population, and little that it would ultimately repay the expense; but, when the question rests upon the probability of profit to private adventurers, there are other views to be taken, and these, in the present state of agriculture, afford but little inducement to the speculation. But although it may not suit the views of private speculators, or the means of tenants who have only a twenty-one years' lease for realizing their capital, nor may it be desirable, from other motives, to proceed further at present in the destruction of common rights—yet the improvement of waste will be in most instances found conducive to the interests of the actual possessors of such land when in itself not naturally infertile. There is, however, a very essential difference in the value of waste land to be improved, when viewed with reference to its capability of repaying: thus poor thin clays, or weak gravelly soils, are well known to require extraordinary quantities of manure to render them productive; while peats and

* See the account of those improvements, by James Loch, Esq., M.P.

† Of this some idea may be formed from the fact, that Enfield Chase, consisting of a wet and poor soil, chiefly composed of alternate layers of flinty gravel and yellowish clay —of which more than 5000 acres were inclosed in 1803—was valued by the Commissioners at 23*l*. 16*s*. for each common right, which varied from half to three-quarters of an acre; and such was the avidity with which the lots were purchased, that many of them sold in large parcels, from 34*l*. to 38*l*., some so high as 50*l*. to 100*l*., and the lowest average was 27*l*. per acre.—Surv. of Middlesex, 2d Ed. p. 138.

‡ *Loch, on the Improvements of the Estates of the Marquess of Stafford*. p. 203.

clays of a strong nature can be brought into activity by the caustic effects of lime, and have in many cases repaid the cost within a period sufficiently short to leave a handsome profit to tenants; in proof of which we need only allude to the account given in Chapter xvi. p. 355, of this work, corroborated, as it has been, by several Prize Essays on that subject lately presented to the Highland Society of Scotland *.

A tract of waste land near Wick, consisting of 156 imperial acres, was taken in the year 1824 by Mr. John Leith on an improving lease, at the yearly rent of 31*l.* 6*s.* The greater portion of the land consists of a strong clay soil, and the remainder of bog or moss; and when the operations were commenced, its only produce was heath and a coarse kind of grass called "bur-grass." With the exception of the mossy part, the land was favourable to culture, and presenting no particular obstacle to improvement, it was brought into entire cultivation during the course of the following years to 1828, with the exception of one acre of deep moss, which was not sufficiently dried to admit of being ploughed. The only manure applied to the land was a compost of moss and clay mixed with herring-guts, obtained from the neighbouring fishing-stations, in the proportion of eight or ten cart-loads of clay or moss to one of the guts, and laid on early in the spring at the rate of from 50 to 60 loads of compost per acre for the first crop of oats, and a fourth part less for the second. The soil received no other preparation than being once ploughed, after having been broken up, except in some wet places, where it was necessary to give it a previous harrowing to fill up the deep cuts occasioned by driving out the compost; and the average expense of cultivating the first crop, exclusive of rent and seed, is calculated at 5*l.* 6*s.* 6*d.* per acre, namely—

Ploughing and harrowing	£0 13*s.* 6*d.*
Expense of guts, mixing, trenching, &c.	1 10 0
Driving out and spreading compost	1 3 0
Clearing large stones	0 10 0
Drains	1 10 0

The following statement shows the produce and the estimated value of the crops raised during that period:—

Years, and No. of Acres brought each Year under the Plough.		No. of Acres each Year in Crop.	Crops raised.		Value.	
1825	54	54	214 qrs. oats at 21*s.* 4*d.*			£228 5*s.* 4*d.*
1826	30	66	273 do. do.	30 8	£418 12	
		14	Turnips	75	52 10	
		4	Potatos	120	24 0	
						495 2 0
		84				
1827	34	93	371 qrs. oats at 21*s.* 3*d.*		£395 14 8	
		16	Turnips	75	60 0 0	
		4	Potatos	120	24 0 0	
		5	Tares	75	18 15 0	
						498 9 8
		118				
1828	37	111	443 qrs. oats at 21*s.* 4*d.*		£472 10 8	
		16	Turnips	75	60 0 0	
		4	Potatos	120	24 0 0	
		6	Tares	75	22 10 0	
		18	Hay	75	68 10 0	
						647 10 8
		155				£1869 7 8

On this it may be observed, that although we by no means accord in the propriety of the repetition of the corn crops, and that no charge appears to

* See vol. ii. of the last Series, vol. iii. p. 220, and No. xxv. in vol. iv.

have been incurred beyond those of common culture, yet the improvement is said to have been attended with such complete success, "that the land now bears crops hardly equalled by any in the country." The expense of reclaiming land varies indeed so much with the nature of the soil, and the localities of situation, that no account of outlay in one instance can be regarded in any other light than as affording some general data for other calculations on the subject.

In 1825 the improvement of about 260 acres of moor-land, not worth more than two shillings the acre, was undertaken by Mr. Hewatson of Drumboy. The soil consisted of peat earth, from six inches to many feet in depth, partly resting on a white clay, or partly on a white gravelly sand, and the whole was covered with heath and bent, except a small spot of bog. The process was begun by burning the heath, levelling the surface, and carrying off the water by drains 2 feet wide, and 15 inches deep. After this, from 9 to 10 cart-loads of lime were laid per acre, and the next two following seasons the land was ploughed each time about 3 inches deep, until the furrows reached the depth of about 7 inches. Instead, however, of harrowing in the common way, a harrow was composed of a quantity of brushwood bound together to preserve the furrows whole; because, in the opinion of Mr. Hewatson, when they are broken, the roots of corn and grass are prevented from taking firm hold of the soil. It was sown each time with oats; the first crop of which was unproductive, and the result of the operation was as follows:—

	EXPENSES PER ACRE.	£.	s.	d.
1826.	Burning 10½d. draining 5s. 2½d.	0	6	1
	Lime, 48 bushels per acre, at 9d.	1	16	0
	Carriage and spreading	1	10	1
	Ploughing	0	15	8
	Harrowing, &c.	0	2	10½
	Water furrowing	0	2	0
1827.	Ploughing, seed, sowing, &c.	1	18	5
1828.	Do. do. do.	1	19	3
	Four years' rent	0	8	0
	Interest of money expended	0	13	3½
		9	11	8
	Value of crops, exclusive of harvest work	9	4	5
	Balance	0	7	3

The land has been since laid down in grass, and is now considered worth eight shillings per acre, at a moderate rent. This certainly is not so flattering a result as some which have been obtained from other experiments of a like nature: but the lime appears to have been applied in too small a quantity to be of any essential use; and, judging from the expense of the drainage, it cannot be supposed to have been very effective. It appears, indeed, that although most of the other reports forwarded to the society are favourable to the improvement of waste by tenants, yet one account of 190 acres under a sixteen years' lease is stated to have left a loss of 1500*l.*; but the increased value to the landlord, under the new lease, is calculated at not less than 2000*l.*

According to the experience of the reporters, deep ploughing was generally found to be so expensive an operation in the first breaking up of the soil, that it was afterwards abandoned; and paring and burning the second time was found to exhaust the soil to such a degree that it, after some time, only throws up spurrey and sorrel. Upon soils which rest upon a dry bottom, potatos and turnips were found the most productive crops after breaking up.

The first thing to be done in the improvement of waste is to provide passable roads to every part of the land; then, to fence it, in inclosures as nearly square as the ground will admit; and lastly, to drain it completely: the latter is, indeed, an operation so essentially necessary, that, until it be thoroughly effected, any attempt at successful cultivation will be found nearly abortive. In grubbing up bushes and furze, the surface soil is very often incautiously turned under the worthless sub-soil, which is brought up instead of it, and is in most cases so sterile as to be scarcely susceptible of aiding vegetation. It is indeed evident, that whatever strength there may be in such poor ground, must have been derived from the annual accumulation of the decayed herbage, which in the course of a long series of years becomes converted into mould: this error should therefore be avoided as far as it may be possible, though it requires great care, and is only feasible to a certain extent. If real justice is meant to be done to the land, all this unprofitable brushwood should, however, be burnt upon it, and the ashes ploughed in with a very shallow furrow. The dwarf heath and the roots of bent and other coarse grasses, are also found to be of a very imperishable nature, and render the land so spongy that heavy rolling will scarcely bring it down to a proper consistence. The plants come up well, and continue to thrive until nearly half grown, at which time they are subject to decay; but when pared and burnt that inconvenience is avoided, and, when the soil is intended to be brought under the plough, it is an operation which should never be omitted.

A very great difficulty often occurs in bringing moor land under tillage through the existence of the moor-band, or pan, which generally consists of sand and gravel, found at various depths between the first and second stratum of the soil, and from half an inch to three or four inches in thickness. It is quite impervious to water, and is so difficult to be broken by the plough, that there is sometimes no other means of effecting that object than by trenching with the pick and spade; an operation which is not only ruinously expensive, but which sometimes brings large quantities of stones to the surface of the ground, and occasions the further charge of carrying them off. The process of ploughing is, indeed, so difficult, that in the breaking up of a considerable quantity of waste land, which has been lately brought into cultivation at Peterhead, in Aberdeenshire, it was found necessary, after removing the heath and dead moss, to employ a plough with four horses and four men, who were engaged as follows: one with a pick and spade made a hole which reached below the pan, and another guided the plough into the hole, while a third held down the beam, and the fourth took care of the horses. Had not these means been taken, the plough would have ran upon the pan, as it might have done upon a sheet of iron; and it was not until after all this exertion in breaking it, and then bringing it up with the grubber and harrows, that it was brought into a sort of mould; for, when exposed to the air, it loses its adhesion and moulders into dust *.

In this operation, the subsoil plough, described in the last chapter, p. 466, would no doubt be found a valuable acquisition. The land should then be cross-ploughed and harrowed; if a moderate quantity of lime be applied, it will be found a great improvement; and for the further management we refer to the chapter on paring and burning. To this, however, we must add, that, if the land lies high and dry, it can never be so profitably employed as in the feeding of sheep; for, if opened by the plough, unless the soil be of a

* See the account of the improvements made on the estates of Auchtigall and Collilaw, by the Governors of the Merchant Maiden Hospital of Edinburgh, in the Transactions of the Highland Society, N. S. Vol. ii. p. 165.

superior quality to that generally considered as waste, the crops will prove light and unproductive. If, therefore, it produces anything like a smooth sward of herbage, the cheapest and the surest mode of permanent improvement will be merely to apply a top-dressing of quick-lime to the surface without breaking it up, by which means the natural grasses will be rendered so much better as in a few years to be termed good down pasture. Or the sward may be materially improved if the heath, bent, and foggage be set fire to when in a dry state and burned. This occasions no expense, and only requires care to prevent the fire from spreading beyond certain bounds; it must, however, be done early in the spring, as the operation is prohibited under penalties, if continued after the 10th of April.

A far greater nuisance than has ever been justly attributed to the existence of waste land under commonage, exists in those small copyhold properties known as *common fields*, which being held by very ancient tenure, when the land immediately around the villages was cultivated by the joint labour of the inhabitants, very generally consists of good soil. A separation of interests having since taken place, these holdings have been divided into such inconsiderable patches, that the farmers cannot in many instances till the ground in a workmanlike manner; and, as the crops must be off the land at a certain period of the year, in order to admit the villagers to turn their stock upon the stubble, no ameliorating green crops can be grown, nor any improvement be made in the impoverishing rotation usually adopted, by which large tracts of excellent land are rendered comparatively unproductive.

Common meadow is also subject to the same inconvenience; for the hay must be invariably mown, and although in some places the quantity of stock allowed to be turned in is limited, yet the number having been fixed in old times, when the cattle were not of near the size which they have reached in their present improved state, it is in no instance sufficient for their support. Thus, miserable half-starved animals are reared; and being left upon the land during the greater part of the winter, they poach it to such a degree as to render the crop of hay both small in quantity and poor in quality; for it may be supposed that, under such circumstances, the condition of the ground is quite neglected, and it is in fact left, in most cases, in a state of nature. Were an act of parliament so framed as to allow of the general inclosure and sale of these lands, it would not materially interfere with the rights enjoyed by the poor upon those commons, which are open to occupation all the year round, and a healthful equivalent might even be granted to them in the establishment of a village-green for the resumption of their former rustic sports.

FENS,

Though all characterized under that denomination, are yet of different qualities, as they arise either from springs in low situations, or as they are formed by the alluvial deposits of rivers, and in some places by the sea.

The former constitute that great level, which extends itself through six counties in the eastern parts of England, and is by much the largest and the richest plain in the United Kingdom; the ground being very generally cultivated with great industry and intelligence, and, when thoroughly drained, producing very abundant crops. The land, however, is not perfectly flat, nor is it of one quality: that which lies the lowest is rather light, and much of it rests upon peat, which is so extremely difficult of drainage, that large sums have been lost in fruitless attempts to lay some parts of it dry; but when incumbent upon clay, that operation is much easier, and when

properly effected, the soil then becomes very valuable. The second-rate land is more elevated, but is still lighter, and in all respects inferior for cropping, but sweeter for pasturage. That of the first quality is a rich black loam with a subsoil of mild clay, or in some places of pure silt, without any intermixture of peat, and forms very fine grazing land.

The foundation of the husbandry on these soils is—to commence with paring and burning; the first crop is invariably cole, eaten off and followed by oats *, generally succeeded either by another crop of oats, or by spring-wheat, sown along with grasses; but if seeds be not sown, the land is the next year well fallowed and sown with cole-seed, which is allowed to stand for a crop. Oats are then again taken for the following year, and the land is laid dow for a series of years to meadow and pasture; but a general opinion is entertained among the most intelligent farmers, that the wet, cold lands of the fens should in all situations be brought under the plough for two or three years in twenty†.

When well managed the soil of the fens is peculiarly productive, and its crops commonly cover the ground and keep it cool in the hottest weather; but when the land has been impoverished by too frequent tillage and exhausting crops, the grain suffers much in dry summer seasons. Great quantities of marl are known to exist under many of the fens, particularly under those situated in the Bedford Level, and its application to the land has in all cases been found a most essential improvement.

The sea-fens are raised in a long succession of years by the sediment left by the overflowing of the tides until the land arrives at the height of the ordinary level of spring tides, when it may be safely embanked, if the further encroachments of the sea are not prevented, as they are in many places, by natural banks of shingle thrown up at the level of low-water mark. The soil, if left until it has gained a sufficient accumulation of matter, generally consists of a tender, soapy, hazel-coloured loam on a subsoil of silt, or fine sea-sand, and is covered with a thick matting of all the grasses peculiar to its situation, forming those rich feeding grounds known under the denomination of *salt marshes*. The original deposits, however, seem to have been composed of a black tenacious clay, or common sea-mud, of a tough and crude nature, of the most rigid and untractable description: thus when embankments have been prematurely made, they have seldom failed to disappoint the expectations entertained of them, and they have invariably been found more or less valuable, in proportion as they have occurred between the points of high and low-water mark ‡.

Fens, of which the soil has been accumulated, either naturally, or by the operation of warping, also constitute land of extreme richness; and being susceptible of becoming raised to the level of the common tides, from which they are easily embanked, they can be rendered as dry as any other ground of an equal level, though subject at particular seasons to be overflowed, for which reason they are very generally retained as feeding-land, or *marsh meadow*.

WARPING

Is an ingenious mode of converting the sediment of muddy streams into fertile land by means of embankment. It has been very anciently

* See the Huntingdonshire Rep. Append. p. 299; also that of Cambridgeshire, p. 203.

† Essex Rep. vol. ii. p. 126.

‡ See Vancouver's Survey of Devonshire, chap. xi. sect. 3. Large tracts of the ground called "*Polders*" have also been enriched by the gradual deposition of sediment left by the sea; and, being now embanked, form some of the finest feeding land in Flanders. Radcliff's East and West Flanders, Chap. i. sect. iv.

practised in many parts of Italy, and some of the richest soil in all Tuscany has been thus gained; but in this country it has not been introduced so much as a century, and has yet only been partially brought into use. The rivers which in that part of Italy descend from the Apennines, become swollen in the rainy seasons into torrents, which carry along with them great quantities of earth, giving them the appearance of streams of mud, with which they overflow the land if not confined within proper bounds. In order to prevent this devastation, the neighbouring marshes have been in various instances inclosed with high and strong dikes, which impede the general encroachment of the water, but admit it through sluices constructed in the upper parts of the inclosure, where it in a short time becomes stagnant. A sediment of slime is thus left upon the land to the depth of sometimes three or four inches, and, when the water has become clear, it is then allowed to pass off at the lower flood-gate. The operation is repeated as often as the season will permit, and in the course of a very few years the land is thus not only raised sufficiently high above the level of the river to prevent any future inundation, but the hollows being all filled up, it acts as a drain from the surface, and becomes rich in proportion to the quality of the earthy matter with which it is covered *.

It is evident that the sediment which the water contains must be rich in vegetative matter, or it would not be worth retaining; and, also, that the stream must be at perfect command. In England, therefore, this improvement has been almost confined to those rivers which empty themselves into the great estuary of the Humber, which is strongly impregnated with a species of mud of extraordinary fertility, called *warp* †, and which is made to deposit itself upon the neighbouring banks by the tides. The process, as detailed in the Report of the West Riding of Yorkshire, is as follows:—

The land to be warped must be dammed round against the river, with banks made of the earth taken on the spot, and sloping six feet,—that is, three feet on each side of their top or crown of the bank, for every foot of the perpendicular rise. Their top or crown should be made broader or narrower, according to the impetuosity of the tide, and the weight and quantity of water which the dams are meant to confine, and extends from two to twelve feet; their height must be regulated by the height to which the spring tides flow, so as to exclude or let them in at pleasure. In these banks there are more or fewer openings according to the size of the ground to be warped; but in general, they have only two sluices—one called the *flood-gate*, to admit, and the other the *clough*, to let off the water; which are enough for ten or fifteen acres. The cloughs are walled on each side, and so constructed as to let the water run off between the ebb of the tide admitted and the flow of the next; and the flood-gates are placed so high as to be above the level of the common tide.

In this manner the land is sometimes raised by the warp, in one summer, from six to sixteen inches; and the nature of the soil underneath is of such little importance, that moor-land which, before it was warped, was worth

* As an instance of the spirit with which such improvements have been carried on by individuals, it is mentioned by M. Simonde, in his account of the agriculture of Tuscany, that a dike constructed around a portion of the estate of the Marquess of Terroni is nearly three miles in circumference, and of such solidity that a road has been formed along its summit, p. 16.

† This substance was found upon analysis to contain mucilage, with a very minute portion of saline matter; a considerable quantity of calcareous and probably aluminous earths; the residue mica and sand; the latter in by far the larger quantity, and both in very fine particles.—Lincolnshire Rep., p. 318.

only one shilling and sixpence per acre, has, since that operation, been let at fifty shillings. The luxuriance of the crops thus produced is, indeed, so great, that beans have been known to yield 90 bushels, and potatoes from 360 to 580 bushels per acre; of clover, after Lent corn, three tons per acre have been also grown from the first cutting, besides a second crop and abundant aftermath; and although these are, certainly, beyond the average, yet the common crops are unusually large. The land, however, should not be sown with wheat until it has been somewhat exhausted by the growth of potatoes, flax, or rape-seed, and laid down with clover. It will afterwards require dung; but the greatest care is necessary to be observed in its cleansing, for the warp is of itself extremely productive of rank weeds.

The expense of this mode of improvement it is not easy to calculate, for it depends upon a variety of circumstances, which vary with the situation of the land. Arthur Young estimates the cost of a sluice five feet in height and seven in width, adequate to the warpage of fifty acres, at a moderate distance from the river, at from 400*l.* to 500*l.* *: but the greater the quantity to be warped, the less will be the proportionate expense. We are told, indeed, of a farm in Yorkshire, of 212 acres, which was purchased at 11*l.* per acre, and after being warped at the charge of 12*l.* more, was afterwards considered worth 70*l.* per acre. But there are, no doubt, many small muddy streams, in which the current is not so impetuous as to require very strong banking, or expensive masonry in the formation of the sluices, which might be greatly improved in value at far more moderate cost. There must, however, in all cases, be a considerable delay in the return of capital; for warping can only be carried on, with any degree of advantage, during the summer months: and from the time when the works are commenced, until that when the soil is sufficiently raised and dried to support a crop, hardly less than four years can be allowed to elapse.

Chapter XXX.

BOGS.

It is not our intention to enter upon a discussion of the means of draining the great bogs of Ireland, for that can never, as we conceive, be accomplished, except by rendering it a national concern †; but on many estates,

* Farmer's Calendar, p. 394.

† A large sum of money was many years ago granted by Government to ascertain the capability and expense of draining the bogs of Ireland, and experienced men were appointed as Commissioners for this undertaking: from the report of one of these, (Mr. Nimmo, a very intelligent engineer,) the following extract is taken:—

"*Drainage*, one would have imagined, in such a country as Ireland, with so moist a climate, so many extensive morasses, lakes, and watery flats, should have attracted the earliest attention, and be now well understood. From various circumstances, however, arising either from her political troubles, or the late period at which her people began to study the means of agricultural improvement; we search her history in vain for any attempt to recover these wastes, or even to free the fertile bottoms along her rivers from periodical inundation.

"The radical cause of this apparent neglect is the want of co-operation, rather than of capital; for, in a country abounding in hands, all that is wanted is, to set them to

both in that country and in Scotland, there are large patches of bog, which, although they supply turf, as fuel, to the neighbourhood, and in some situations, where firing is scarce, and only a limited extent of bog fit for the purpose would doubtless occasion much distress among the poor were they deprived of this resource, yet might, in most cases, be much more beneficially cultivated. The deficiency of capital and skill among the greater proportion of Irish farmers, prevent, indeed, any efforts of the kind on their part; but these are objections which cannot be said to exist amongst the large landholders; and there can be no doubt that the value of their property might be very materially increased, were more attention paid to the draining those swamps, besides improving the dreary appearance of the country, by which it is now very much disfigured. Some spirited attempts have, it is true, been made on this subject, and they have, in most instances, been attended with success. Where they have failed, it has been occasioned by insufficient means of drainage, as well as the too free use of

work. The numerous and idle poor already exist, and are supported: no additional expense can therefore fall on the community by employing them in useful works, over what is at present required to keep them in unproductive and often mischievous idleness.

"We have many industrious and improving land-owners and lessees, who are disposed to contribute their proportion towards draining the morasses, or clearing the courses of rivers and streams which disfigure their own and their neighbours' lands; but from the inability, indolence, or obstinacy of some of their neighbours or tenants, the variety and intricacy of tenures under which their lands are held, the consequent difficulty of ascertaining the relative benefits and levying the just proportion of contribution, these improvements are altogether prevented; or, if attempted in favourable cases, are confined to the lands of an individual, whence they are usually rendered unnecessarily expensive to the undertaker, and but partially successful.

"The remedy for this is, obviously, some legislative enactment which would empower properly qualified and disinterested persons to ascertain the extent of injury and the probable benefit to each individual concerned; to lay down and carry into effect all such measures of improvement as appeared to be for the general benefit; and to defray the expense of an assessment or tax proportionate to each person's interest in the benefit received.

"But in drainage we have not advanced to the state in which England was two or three centuries ago. Commissions of sewers are very ancient, though first regulated in the reign of Henry VIII. by a general law, which is still acted on. In the reign of James I. the great fens of the east of England were surveyed in the same manner as the bogs of Ireland have been; and doubts having been urged how far the powers of a Commission of Sewers could be extended to the construction of new works, or to the levying of assessments for general purposes in any other way than according to individual benefit, the drainage of these fens was proposed to be undertaken as a national work, under the immediate authority of government, and engineers were brought for that purpose from the Low Countries. The troubles of that and the succeeding reign prevented the execution of this idea; but in the course of that century, and after various interruptions, this great measure was effected by means of private companies incorporated under particular acts of parliament.

"In carrying into effect the drainage of any district in Ireland, there might appear to be an invincible obstacle to raising the necessary funds, at once, from the lands to be drained, on account of the variety of tenures and number of derivative interests which intervene between the proprietor in fee and the occupier of the soil; but on this head we may observe, that the commissioners for granting loans to public works from the consolidated fund are empowered to advance money towards the expense of any drainage, at the rate of 5 to 6 per cent. per annum; and, since this interest or assessment will only constitute an annual tax, no person will be called upon to pay but in proportion to the period of occupation; and the landlord, when the lands revert to him, may, if he lease, discharge the principal sum.

"A very considerable portion of the sum allowed by parliament still remains in the hands of the Commissioners aforesaid; how long it may continue unappropriated, or if ever it will be increased, is difficult to say; but, at all events, the present seems a favourable period for an application to this fund, in the same way, and on similar terms, to that already adopted for the Eaubank cut, near Lynn, in England, one of the great works intended for the more complete drainage of the Bedford Level."

corn crops after the land has been brought under cultivation; and the most profitable mode has been found to bring them into meadow, for the soil is generally too tender for the constant operation of the plough.

Most of the great fens in England have now, indeed, been brought into such a dry state by drainage, as to produce abundant crops of the finest wheat; but the soil which they contain is generally of a much richer quality, being composed of a greater quantity of decomposed matter, and also less fibrous and spongy, than that which is to be found in the bogs of Ireland.

It is indeed said, that the peat soil in Ireland, which is estimated at 2,800,000 acres, consists, in great part, of red bog, which, although less valuable than that which is black, is capable of being converted into the general purposes of agriculture. This, however, is carrying the speculation rather too far; for, although much of the red bog, when well reclaimed, makes good meadow, yet it generally requires many years of good management before it can be depended on to yield fair crops of wheat or barley. It is of various depth and quality; but if selected with prudence and discernment, and judiciously cultivated, it will generally pay well under rape, oats, potatoes, or turnips, preparatory to its being laid down with grasses; there consequently cannot be a sound objection to bringing the chief portion of it into a state of culture. There are, besides, many thousand acres of waste land, or what in Ireland is called *mountain;* but which may be more justly denominated marsh, which might be effectually reclaimed by the simple operation of draining, yet are allowed to remain in their present unprofitable state to both tenant and landlord*.

Numberless essays have been written on the reclamation of these bogs, and the subject has lately attracted public attention; but most of these treatises represent it in far too favourable a light; for, although some of the recorded experiments show that land which was previously worthless has been thus brought into such a state of improvement as to produce a rent of 40*s*., and even 3*l*. per acre, yet these are isolated instances, which ought not to be assumed as grounds of general average. We therefore pass them over, and shall confine our observations to a very unassuming volume lately published by an Irish gentleman, who places the matter in a more dispassionate, and, we think, a more rational point of view, than his fellow writers †. Some, even of the Commissioners who have reported to the House of Commons upon the subject, have calculated the value of reclaimed bog, without distinction, so high as thirty-five,—and others, more reasonably, at twenty shillings per acre,—yet this person is of opinion, "notwithstanding the high and much more able authority of those gentlemen on the subject, that even the latter rent of twenty shillings is much too high an average rent for such lands." A great portion of them would, he has no doubt, remunerate; but a return adequate to the outlay would be more than doubtful, on a still greater portion. He estimates the average value of those wild bogs, when fully reclaimed, as not exceeding ten to fifteen shillings per acre; or three such acres as not being worth more than one of a sound dry soil.

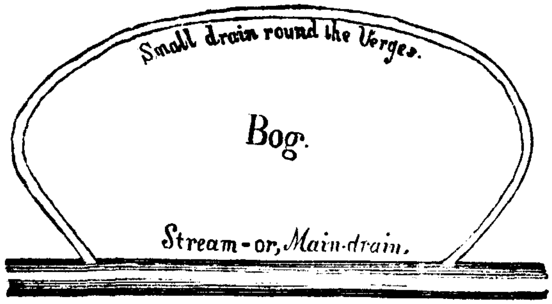
It must also be recollected, that, in four cases out of five, the interior of the bog will cost double the sum per acre to reclaim that the verge will; as it is not only further from the clay, lime, or gravel which may be required in its improvement, and the road softer, but the centre generally consists of

* See Burroughs on Practical Husbandry, Essay iv. s. p. 40 and 56.

† See Observations on the Rural Affairs of Ireland; and a Practical Treatise on Bogs and Wastes, &c., by Joseph Lambert, Esq., pp. 162 to 198.

peat, which is more fibrous than that which is at the outskirts, and is, consequently, not only of inferior quality, but more difficult to be brought into cultivation. On small or moderate sized bogs, consisting of from 50 to 150 acres, he therefore suggests the following mode of improving and reclaiming those verges:—

A river, lake, or stream is generally found to run either through or by the side of a bog, or to have some immediate communication with it, and this should be made the main-drain, taking care to ascertain that it affords a free and uninterrupted passage for the water. The bed should also be cleaned and deepened, if the stream runs sluggishly; and its course should be straightened, if it is subject to become choked. If there is no stream, a deep artificial main-drain must then be cut, with a sufficient outlet in the lowest part of the adjoining ground; and, communicating with that, a smaller drain must be cut round the interior of the bog, between its worst parts and those reclaimable verges, so as to catch all the water from the overhanging centre; thus following its direction in a somewhat circular form, and discharging itself at both ends into the main-drain or stream, in the manner designed in the annexed sketch.



Another drain of a similar shape as the last, though not near so deep or wide, may also be cut between the dry ground and the verge of the bog; but this must be determined by the state and firmness of the land, as bog may be drained too much.

Besides completely separating the more valuable verge from the central part of the bog, this drain will also render essential service by allowing the latter to consolidate, and with the addition of some smaller drains, to become, in time, fit for further encroachments. Considerable judgment is, indeed, requisite in constructing drains of a depth suited to the nature of the bog; for their object should be, to carry off the water from the *surface only*, but not to deprive the entire body of the soil of its moisture. Spongy and deep mosses, in particular, would be materially injured by being made too dry under the surface; as were there too great a depth of dry fibrous substance to receive the rain, it would be too quickly absorbed, and, together with the effect of the summer heats, they would be entirely deprived of humidity, and rendered unproductive *.

When these verges have been thus thoroughly drained, two methods may be pursued in their further improvement: one, by leaving the surface unbroken, and spreading limestone-gravel upon it; the other, by tillage and cultivation. The first is the least expensive, and, when the surface is smooth, and the waste inclined to grass, will also be found, in most cases, to afford the surest return for the outlay; for, if this gravel, which is

* Burroughs on Converting Waste Land to Profit, p. 37.

found in most parts of Ireland, be of a good loamy quality, and spread liberally on the surface, the skin, remaining unbroken, will prevent it from sinking in too much, and it will produce natural white clover in abundance. Marl of a rich kind will also have much the same effect; but lime will be found nearly ineffectual on deep boggy land, unless heavy substances are first laid upon its surface *. A good pasture will be thus obtained, and moss lands are more valuable for grazing than for the purposes of tillage.

When the surface is much broken, or overrun with rushes, fern, heath, or noxious plants of any kind, it will, however, be necessary to adopt the plan of tillage, for the purpose of levelling the land and destroying the roots. The usual mode is, by burning a certain proportion of the surface, both in order to destroy the superabundant vegetable matter which it contains, and to supply manure for the intended crops, three of which, at least, it will be necessary to take before the land is laid down with grass-seeds. It has, indeed, been recommended by some writers, to burn twice, for two successive crops, as the only effectual method of bringing such land into a mellow state; but it is a practice the adoption of which we by no means advise †. The first crop is usually rape; but it is commonly very ill-managed, the land seldom receiving more than one indifferent ploughing after the ashes have been spread, and not being even harrowed preparatory to the seed being sown, so as to blend the soil and manure together, and to leave an even surface for the deposit of the seeds. It has, however, been plausibly said in defence of this practice, that the rape plants resist the injuries they might receive from the frost better when the land is left in a rough state; and that the soil falling, during the winter, from the high parts of the surface into the furrows in which the plants grow, they are thus strengthened and protected during their growth. The common rotation is often two successive crops of rape, or alternate crops of rape and potatoes, with oats, followed by seeds, the grass of which is mown the first year, and should be only fed with sheep or light stock during the following season or two, to prevent its being poached ‡. A thin coat of gravel, road-scrapings, or clay, should then be laid on to give firmness to the soil, for corn will not be productive on bog without some such manure, and, particularly in wet seasons, will not fill the grain. Neither will such land return dry or good potatoes, either for eating or for the fattening of cattle, unless its staple be rendered dense by this assistance; and if a good sward can be created, it will generally be found the most prudent plan to continue it in pasture, with a future improvement by lime. On such wet soils there can be little doubt that fiorin might be advantageously cultivated: it would also be a great additional improvement to plant a belt of Scotch firs around the inside of the circular drain, so as to form a shelter against the chilling winds, which, on bleak moor and bog lands, are a great check to vegetation. This tree is peculiarly adapted to peat soils; and although its timber is not valuable, nor does it arrive to any great size, yet, if a few spruce-firs be added on the sheltered side, with a thick hedge of broom or gorse, to close the screen at the bottom, the plantation would, in a few years, become a very desirable protection against the inclemency of winter §.

It is evident that bogs sometimes originate from water breaking out of the adjacent heights along their upper side: at other times, from springs

* Burroughs on Converting Waste Land to Profit, p. 39.

† See Chapter XVI. on Paring and Burning, and n. p. 435.

‡ Burroughs on Converting Waste Land to Profit, p. 43.

§ See the Essays on Planting, by the late Mr. George Sinclair, in the Farmer's series of the Library of Useful Knowledge, Nos. 19, 20, 22, and 23.

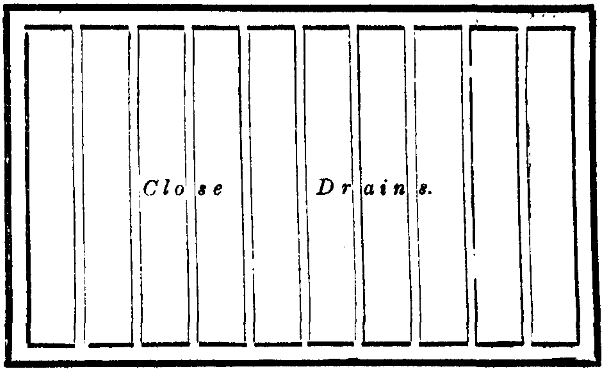
rising promiscuously over the whole surface; and not unfrequently, from both these causes conjoined. The pressure of the water in the high ground thus forces that with which it is connected under the bog, through the more porous parts to the surface,—forming quagmires, which are dangerous to be walked upon, and which are easily distinguished by the verdure of the surrounding grass. Much ground still lies waste from such causes, though not containing peat; and in draining such land, it has been remarked by Mr. Stephens, (whose work we have already quoted,) as follows:—

That "when the water breaks out on the upper side of the moss, a drain must be carried along the line of the wetness, sufficiently deep to intercept it, with outlets to the cross-drains, which must be cut to such a depth as to suit the level of the outlet. If the extent of the land to be drained be considerable, it will be advisable to divide the whole by open drains into fields, according to the position of the ground. The drains should be made from five to six feet deep, and where this depth does not reach the bottom of the moss, or to the stratum containing the water, bore-holes, or wells must be made in their bottom, through which the confined water will rise by its own pressure to the bottom of the drain, so that it will be reduced to the same level. The bore-holes are made with an auger about five inches in diameter; but when the moss or peaty earth is so soft that they will not keep open, wells filled up to the bottom of the drain with small stones must be made. These operations will not only prevent the springs from the adjacent high grounds overflowing the moss, and remove the subterraneous water, but will also, in most cases, completely free it from surface-water proceeding from rain or snow: when, however, any of the latter remains, it must be remedied by wedge or shoulder-drains, which, if properly executed, will last from twenty to thirty years." For a further elucidation of which principles, he refers to descriptions and plans selected from many other similar operations in Sweden, which we do not consider ourselves authorised to copy.

With regard to reclaiming wild moss-lands, or the central parts of bogs, without discrimination, Mr. Lambert does not feel so sanguine as some of the Commissioners who have reported to the House of Commons; but as some proprietors may be desirous of making the attempt, they probably cannot pursue a better plan than that adopted some years ago for the improvement of Chat-moss in Lancashire, consisting of some thousands of acres, which was quite as deep, wet, and fibrous, as most of the bogs in Ireland, and comes up to the idea of what is there termed "*red-bog*," the turf cut on it for fuel being yellow, light, tough, and spongy; yet, potatoes followed by wheat have been grown upon it of very excellent quality. It should, however, be observed that it was manured with a peculiar species of stiff marl *, as well as with the street-sweepings of Manchester; and it, not improbably, was more to that species of dressing, than to any other kind of improvement except that of good drainage, that the perfection of these crops is to be attributed. Trees of various kinds—larch, beech, spruce, Scotch fir, and poplars,—particularly the two latter,—thrive upon it; and that portion which has been laid down to grass makes very tolerable pasture.

The mode of drainage was very simple. The moss was divided into compartments, right and left, on either side along a straight road leading to its centre, each division being 100 yards long by 50 wide, and, therefore, containing about an acre. These divisions were surrounded by an open drain three feet nine inches deep, three feet wide at the top, and

twenty inches at bottom. The cross-drains were covered, and cut across to the open surrounding ones at every six yards distance, being only twelve or fourteen inches wide at the top, and continuing nearly the same breadth for about two feet two inches to where the shoulders are left on each side; the cut to the bottom being eight inches wide and sixteen inches deep. They were formed on the same principle as the catch-drains described in fig. 1, page 452, viz., with a shoulder to support the reversed surface turf over a wedge-shaped opening in the bottom; but when moss-land is drained for the purpose of arable cultivation, the catch or hollow drains are made much deeper. In moss-draining, no straw, or brushwood, is used in the drains; the tough surface-spit of the moss being at once a durable wedge to keep the sides apart, as well as a cover.



The drains were cut in the usual manner; but only about one foot in depth at a time, being left to dry and become hard at the sides, without which precaution they would fall in, and the cutting was afterwards continued at intervals until the whole was completed. The bog was, indeed, so soft that the men were obliged to have small boards, every way larger than the foot, fastened on their feet with straps, to prevent their sinking. The estimated expense was only 31*s*. 6*d*. per acre. The surface of the bog was then pared in thick sods, but not in every instance burned, being in some cases left to decompose, and afterwards used as manure; and in consequence of these operations, the moss has sunk considerably, and acquired a great degree of solidity*.

It may, however, be observed, that notwithstanding the success of this improved cut of Chat-moss, it was not effected without a great outlay of capital, and that it is in the immediate vicinity of a great manufacturing district, with the convenience of markets, canals, and railroads, which Ireland does not possess. Speculators should, therefore, weigh these circumstances maturely before they commence any similar scheme of improvement. We would, indeed, hint to them the propriety of attending to the calculations of Tristram Shandy's father regarding the cultivation of the ox-moor with his aunt Dinah's legacy, instead of applying it to the purpose of sending his eldest son Bobby on his travels †. But should it be determined upon, they should then understand—

* Holt's Survey of Lancashire, pp. 96 and 99.

† "Whenever my father took pen and ink in hand, and set about calculating the simple expense of paring and burning, and fencing in the ox-moor, &c. &c., with the certain profit it would bring him in return,—the latter turned out so prodigiously, in his way of working the account, that you would have sworn the ox-moor would have carried

That bogs which produce the best turf for fuel are generally the easiest to reclaim, and make the best land when drained.

That the work should be commenced early in the summer, and continued during the fine weather, or at least, until harvest calls for other occupation; for during the winter it will be useless.

That the soil should be thoroughly drained from all superfluous moisture before any attempt be made to crop it.

That the common manure of the farm should never be encroached upon for such a purpose. Unless, therefore, lime, chalk, gravel, or marl, can be conveniently obtained in the immediate neighbourhood, it would be better to leave such ground in its natural state; and lastly,

That whatever attempt is intended to be made, should be done effectually, or not at all.

Chapter XXXI.

ON GRASS-LANDS—PASTURE—MEADOW.

It is a received opinion among many farmers of great experience, that land may be left too long in pasture; and if it becomes mossy, hide-bound, and overrun with weeds, perhaps there is no better method of improvement than that of paring and burning, and then laying it down again to grass; for, unless the soil be good, it will not, under present circumstances, pay the expenses of cultivation. But old meadows, which already bear a sward of succulent herbage, are too valuable to be broken up with advantage, and they whom the high prices of corn during the late war have tempted to adopt that course, are now severe sufferers. All kinds of stiff clay which have been many years in meadow or pasture, and have become well covered with good sorts of grass are of that description, and, if converted to temporary tillage, cannot, by any system of management, be again brought, within any reasonable period, to bear so good a turf as before they were ploughed *. Efforts, it is true, are making in most parts of the kingdom to lay down much of the land; but, if again restored to meadow, a long series of years must elapse ere it will attain that rich bottom which adapts it for profitable grazing. There is an old saying, that "he who has once got a turf is an idiot if he breaks it up." Experience proves the truth of this; for land of that description fattens beasts quicker, and yields richer milk than that which has been newly laid down; and accordingly, meadow is always more sought after, and the rent is higher, than that of arable. There are indeed innumerable instances in the south of England of old grass lands, separated only by a ditch †, where these fields are worth from 10*s*. to 20*s*. per acre more

all before it: for it was plain he should reap an hundred lasts of rape, at twenty pounds a last, the very first year, besides an excellent crop of wheat the year following: and the year after that, to speak within bounds, an hundred,—but in all likelihood, an hundred and fifty, if not two hundred quarters of peas and beans,—besides potatoes without end."

* Boys on the Means of converting Grass Land to Tillage.—Comm. to the Board of Agric., vol. iii. p. 248.

† Mr. Boys mentions, in the Essay already alluded to, his having two fields of eight acres each, on a stiff clay, contiguous to each other, on a dead level, the soil in every respect the same; one piece supposed not to have been ploughed for centuries, the other laid down about thirty years before his writing; and although both were stocked and managed in precisely the same manner, yet the old grass was worth more than double the other.

than those which have been lately in tillage; although the latter have been laid down on well managed summer-fallows, with the best kinds of grass seed *.

The contrary doctrine is, however, held by almost all the supporters of the improved Scotch system of agriculture, who generally maintain, that the alternate husbandry should be invariably applied to the conversion of grass into arable land; in proof of which they certainly adduce strong instances of the superior weight and apparent luxuriance of recently sown grasses over those which have been many years in the ground; but this may, not improbably, be owing to the deficiency of chalk, which is known to exist in the soil of Scotland, and which perhaps renders it less fit for the support of the natural grasses than other countries which are differently situated. No part of Europe, for instance, produces natural grass of a finer quality than Ireland, and much of it has been immemorially in pasture; but the surface soil lies, almost throughout the island, upon a limestone bottom. It may indeed, be true, that, upon any soil, old grass-land, which has been gradually enriched by the dung of animals pastured upon it, and by the decomposition of a portion of its herbage, will, when broken up, produce more profitable crops than if left in its natural state; but they cannot be continued without the aid of abundant manure, and the cost of their production is in some cases greater than their value; while natural grass always yields a return of some sort to reimburse the farmer without the risk of tillage. It is, however, in many instances greatly abused: the dung made by cattle fed upon the hay being generally applied to arable land, and the pasture hard-stocked throughout the winter; but, as has been justly remarked in one of the Yorkshire reports—" Were the manure of the farm honestly carried to the meadow-ground, that ground the farmer could never wish to see ploughed †." It is indeed evident, that the production of corn exhausts in a few years those principles of fertility which the land in a state of grass had been for a long series of years acquiring; for the matrix of good turf is formed of vegetable mould, which can only be produced by time, and there is a rich luxuriance in the verdure of a fertile pasture which is only imparted by age. " To restore those principles when land so exhausted is again to be laid down to grass, or to prevent its exhaustion during the time it is in a state of tillage, is the great secret of agriculture; for if once known and reduced to a system, the price of the different productions of the soil would soon find a general level ‡." Experience shows, that this

* In some of the Lincolnshire marshes, an acre of their measure—which is however in some places five roods, and in others not more than three—will summer-feed a bullock, together with from two to five large sheep, and two sheep throughout the winter. Thirteen acres have been known to feed 14 bullocks, and to carry 35 sheep the year through; and 21 acres have, during a series of years, kept 19 heavy oxen and 100 sheep, from Lady-day to Michaelmas, besides wintering 50 sheep. The average of the whole is 1¾ acre per bullock, and 3¾ sheep per acre throughout the summer, with 2 sheep in the winter; and the produce thus raised by grazing exceeds that of arable land.—*Lincoln. Rep.*, pp. 218, 219. Mr. Billingsley calculates that, in Somersetshire, a grazier occupying 200 acres of land, (not marsh,) may fatten yearly 110 head of oxen, with 270 sheep, besides feeding 12 colts.—*Somersetsh. Rep.*, p. 239. Five cwt. of cheese have also been made from cows fed upon one acre of pasture.—*Comm. to the Board of Agric.*, vol. ii. p. 320. See also the *Report of a Gloucestershire Vale farm in* No. IV. *of the Farmer's Series in the Library of Useful Knowledge.*

Such instances are certainly above the average; but there are many extensive tracts of natural meadow and pasture, both in this country, and more especially in Ireland, which pay better in grass than they would do if put under the plough.

† Survey of the North Riding, note, p. 169.

‡ Comm. to the Board of Agric., vol. iii. p. 80.

secret has not yet been discovered by the writers in question: to convert grass land to tillage, and that with profit to the occupier, requires no particular rules; but to restore the land again to grass, unimpaired, is a difficulty not easily surmounted. The argument may in fact be summed up under this general rule,—that *all land should be kept in that state in which it will yield the greatest permanent rent to its owner.*

Grass-land is distinguished under the separate denominations of *pasture* and *meadow:* the first being generally ground of a poorer nature and more hilly situation than that used as meadow, though much of it, of the richest quality, is appropriated to grazing; but the latter is the only kind which is reserved for hay, and most frequently consists either of low land of a cold, strong, wet nature, the tillage of which would be difficult; or that situated in the immediate neighbourhood of large towns, in which hay is in constant demand; or, bounded by streams, which admit of its being improved by irrigation. It should, however, be of such a nature that the grass will spontaneously thrive; and this can only be attained—when artificially laid down by cultivation—through close attention to the quality of the soil, and the kind of grasses with which it is to be sown.

PASTURE.

The excellence of pastures depends greatly both upon their position, and upon the different species of animals for whose support they are intended. Thus uplands, which are elevated, open, and dry, are the best adapted for the feeding of sheep; while heavy stock is fed with more advantage upon ground which is lower in point of situation, as well as better inclosed. The soil of uplands—particularly if it be of a chalky nature—bears a sweet, though a short bite of grass, which is so favourable to the pasturage of the smaller breeds of sheep, that although it will support but a scanty stock, it yet produces the finest species of mutton. The cultivation of weak soils is also chiefly to be depended upon by the aid of the fold; and, in that point of view, these pastures are doubly valuable. In some of our southern counties, indeed, manure cannot be otherwise raised in sufficient abundance for the purposes of tillage, and, without its assistance, the plough would be nearly useless. It is, therefore, much to be regretted, that considerable tracts of those *downs*, as they are there called, have been broken up; for neither skill nor expense in cultivation can, within any moderate period of time, replace the natural herbage which they contained: and as they cannot now be kept with profit under the plough, they have become nearly worthless to their present proprietors.

Pasture of this kind also secures sheep from the rot, and in a great degree preserves them from the attack of flies, from which they often suffer severely in small inclosures. Ground where water sometimes stagnates, is always dangerous to sheep; and land which has been flooded, is unsafe until it has become perfectly dry, though there is not much danger when the water trickles over it continually. Thus in the highlands of Scotland, and in some of the mountainous parts of the north of England, Wales, and Ireland, there are vast ranges of hills, which, even during the driest seasons, are constantly moist; yet they do not appear to affect the sheep with the rot*; but the water is in continual motion and never stagnates. In these alpine tracts the pasturage consists of a great variety of plants, singularly adapted to the maintenance of the flocks in every month throughout the year, but varying in quality according to the soil on which they grow; and

* This remark will also apply to the forest of Dartmoor, in Devonshire, which contains upwards of 50,000 acres.—Devonsh. Rep: p. 341.

the greatest difficulty in the management of stock consists in its removal to different qualities of the pasture. Much of it consists of heather, which fills with seed, and ripens in years of ordinary fertility like corn, thus forming the chief portion of the food of stock during the winter months: the ling, or common heather, flowers in August, and is succeeded by the fine-leaved heath which comes into bloom nearly a month later; their blossoms partake of all the variations of colour from a darkish red to pure white, and their leaves show a corresponding variety in their shades, from a dark to a light green. In exposed places the shepherds burn it, and the sheep eat the young plants in the autumn; but in lower situations it is allowed to come to maturity, and they work down to it in time of snow, and in order to afford them shelter in lambing-time. In February the heather has lost its seed, but it is succeeded by other plants, and particularly by thick beds of cotton-grass, which continue in use until the middle of April, during which time they furnish food in great abundance, and of excellent quality for feeding stock. From that time until the middle of May a scarcity is however felt, unless on moderately-stocked and well-drained land, which is sometimes followed by the *hunger-rot* *.

The value of a pasture farm in those districts depends in no small degree upon the variety of vegetation, and upon the shelter afforded by the declination of the ground. The *down-land* of our southern counties does not partake of all the advantages of this mountain pasture: it does not contain the same variety nor succession of plants, and being less humid, as well as more exposed to the sun, it is subject to be burnt up in the summer; but though apparently scarcely affording a bite to the flocks fed upon it, yet the nutritive power of the herbage which remains is so condensed, that they do not appear to fall off in condition; and, as the farms invariably have a portion of arable land connected with the downs, fodder can in pinching seasons be provided for their support.

A considerable difference therefore prevails in the management of the stock fed upon these hill pastures; for, in those of the north, the graziers being commonly unprovided with tillage-land, and thus, solely dependent upon the mountain herbage for the maintenance of their flocks, are necessarily obliged to be very cautious in not overstocking the land; while, on the downs, it is on the contrary considered advisable to eat the pasture down as bare as possible, because it is found that close feeding prevents the coarse plants from running up to seed, and thus preserves the herbage in that state of sweetness which is the most relished by sheep. Indeed, on some parts of the downs where the finer grasses abound, the soil is frequently so loose and porous that nothing but close and constant treading will prevent them from being choked by the coarser kinds; and if suffered to run a year or two without a full stock upon them, they become so sour that sheep will almost as soon starve as eat the grass which they usually produce †.

Land of this nature, as well as that of every kind of poor pasture, is very rarely manured otherwise than by the dung dropped by the animals fed upon it, and is often deprived of that by the practice of folding. Very little indeed seems to have been done for its improvement in any part of the kingdom, though there can be no doubt, that where the soil is deficient in calcareous matter, and inclined to run to coarse herbage, it might be improved by a coat of lime, were not the expense too great to reimburse the

* See the Mountain Shepherd's Manual, and the Report of Strathnaver Farm, No. III.; both published in the Farmer's Series of the Library of Useful Knowledge.

† Survey of Wiltshire, p. 80.

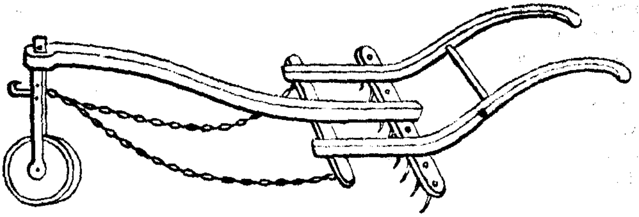
outlay; for it has been found that animal dung, when dropped upon coarse benty pastures, produces little or no improvement upon them, but when lime or chalk has been laid upon the surface, the finer grasses soon take possession of it. Large tracts of furze, rank heath, and fern, might be cleared by the servants of an extensive farm at periods of cessation from their usual labours; and thus, by attention and judicious exertion much might be effected. Were the practice of burning pasture that is rank with weeds and grasses of an unprofitable nature, more frequently resorted to, it would also be found extremely serviceable, without occasioning either expense or trouble that is worth mentioning *. On pasture of a medium rank, fed by larger stock, bush-harrowing should never be neglected, as the dung is thus equally spread over the ground, and prevents, in a great measure, the growth of those rank tufts which destroy its beauty and injure its quality. This operation is, indeed, seldom neglected during the spring, on land which is intended to be mown, but is often omitted on that which is fed, and is never, or only very rarely, performed at any other season, though were it done after the stock are turned off in the autumn, it would then be more effective; and even were it repeated whenever the fields are shut up only for a time to allow of a new shoot of grass, its growth would be thereby much assisted. It would even be useful if old women and children were employed for the purpose of scattering the dung, or even gathering it †.

Scarifying the surface of pasture land is also a mode of improvement which adds considerably to the closeness and luxuriance of the sward, by occasioning the roots of the grass to tiller and acquire fresh power of vegetation. This is effected by merely cutting through the turf so far down as to sever the roots of the grass, which occasions it to throw up fresh shoots. The implement is therefore intended to slice the sod, without tearing it, and should be constructed with a number of very sharp coulters fixed into a cross-beam at such distances as may be thought advisable, from six inches to a foot, and of a width according to the strength intended to be employed in drawing it, though it will act with one horse if not exceeding five feet, and will thus go over a considerable extent of ground. Some artisans make the coulters straight, but this is improper, for they require rather more forward rake than a plough coulter, and perhaps the better mode of forming them is in the shape designed in the cut on the next page: though it has been also recommended to reverse the position of the blades, or coulters, as the points would thereby be prevented from catching the roots; but the instrument must then be heavily pressed down by the man who holds it or otherwise it will not cut the sward to a sufficient depth. The blades

* See Laidlaw, on the Burning of Heath, Quart. Journ. of Agriculture, N.S. No. xxiv. p. 808.

† We have lately seen an account, in which it is stated, that women and children have for some years past been employed to collect the droppings of cattle upon pasture land before they become dry; and it has been shown, that one woman, accompanied by a couple of children, can with ordinary diligence gather nearly a cubic yard per day from horses, though not quite so much from oxen. They are provided with a light wheel-barrow and small spades, with which they lift off the dung, and carry it to a corner of the field, where it is laid upon a bed of earth previously prepared from the scourings of ditches and drains. It is then covered up, and so remains until mixed, and afterwards laid upon the land as a top-dressing. The wages are of course trifling; and although the quantity collected from an acre must necessarily depend upon the number of cattle depastured, yet, in ordinary cases, the saving of manure will be very considerable, for when thus used, it is much more efficient than when the dung is left in the usual way exposed upon the land, besides preventing the generation of insects which there deposit their eggs.—Quart. Journ. of Agric., N. S. No. xxi, p. 386.

should also be occasionally whetted to preserve their sharpness, and the implement should not be used until the ground is in such a state of moderate moisture as will allow of the roots of the grass being cut without being torn up. It is likewise evident that the land should be first close fed; and if either very poor or moss-bound, it should be also scarified across, so as to divide the sward into squares.



It is a cheap and effective tool, and has been used with considerable success, though best adapted to moist clays and mellow soils which do not contain flints or gravel. It may also be advantageously applied previous to the application of grass-seeds, in which the sward may be deficient, as these may be efficiently buried by the subsequent operation of cross bush-harrowing; or, if compost, or rotten manure, be laid on, it will partially carry it down to the roots of the plants. The foot-wheel, it will be observed, is mortised to regulate the depth of work; and although the implement has been constructed with a double row of coulters, yet those fixed in the front beam may be omitted.

Among graziers upon the richer kinds of land considerable difference of opinion prevails, both respecting the propriety of alternately feeding and mowing; also, regarding the size of inclosures, and the mode of stocking them.

On the first point,—*regarding meadowing and feeding*—it is the custom of many to feed the ground year after year, without ever allowing it to be touched by the scythe; and many of the leases of marsh-land contain clauses to prevent its being mown. That much of the land thus treated is capable of feeding beasts to great weight is quite apparent, and there can be no doubt that if alternately mown, without being sometimes manured, it must lose the advantage of the dung dropped by cattle which would have been pastured upon it. But then it is to be observed, that in every pasture which is continually fed by heavy fatting cattle, they commonly leave some rough grass, which, even when eaten down by other stock, will remain until they become pinched by the want of food; while on land which is alternately in meadow and pasture, they regularly feed over every part. Any man of observation may, indeed, perceive, that the animals feed upon those parts where the grass grows short and sweet, in preference to those where it is found in long tufts produced by unspread dung; but if it be occasionally mown, this coarse grass will be reproduced with a fine young eddish, which will be more relished, and will fatten better than the former herbage. Thistles also spring up on such pasturage, and, if not mown off, increase to its great detriment; for cattle cannot eat the grass within some inches of the stem, in consequence of its prickliness, and much of it in consequence becomes useless; but, even if the land be not used as meadow, were those thistles mown off, when in flower, as close to the ground as the scythe can go, they would be kept down, and the cattle

would eat both them and the grass when half withered*. They, and all noxious root-weeds, should even be spudded out as soon as they make their appearance in the spring: it is easily effected when the ground is moist; for as it requires no labour, any old man may be so employed for a trifle, and the expense will be far more than repaid by the improvement of the ground. It may not be so necessary on grazing soils of a poor quality; but whenever weeds grow to such excess as to render grass useless, it is proper on any land. In short, good pastures, if properly treated, should be dressed as regularly as meadows.

The most proper *size of inclosures* has never yet been ascertained by actual experiment; but it was the opinion of Bakewell and many others, that small ones are the best; as, if many cattle are turned into a close together, one restless animal will disturb the peace of the whole number: they are also apt to herd together in some dry or elevated part of the field, the grass on which favoured spot becomes spoiled. Much pasture-land is thus rendered useless in the rich grazing districts of Ireland, while in those of Lincolnshire, Somersetshire, and most parts of Romney Marsh, the greater part of the inclosures seldom exceed ten acres, and many are only half that size. During the winter a large portion of this land is used for feeding sheep, and is generally stocked at Michaelmas at the rate of two to the acre, all other cattle being turned out. The dung is also dispersed, and the thistles being stubbed up both then and again during the following spring, the land appears upon the whole nearly as uniform as a garden grass-plot.†

Respecting the *stocking of inclosures*, it is the opinion of the most intelligent graziers that the cattle fed upon them should be divided in the following manner. Supposing four fields, each containing a nearly equal quantity of land,—one of them should be kept entirely free from stock until the grass is got up to its full growth, when the prime or fatting cattle should be put into it, that they may get the best of the food; the second best should then follow; and after them, either the working or store stock, with lean sheep to eat the pastures close down: thus making the whole of the stock feed over the four inclosures in this succession:—

No. 1. Clear of stock, and reserved for the fatting beasts.
No. 2. For the fatting beasts, until sent to No. 1.
No. 3. For the second best cattle, until forwarded successively to Nos. 2 and 1.
No. 4. For stores and sheep to follow the other cattle; then to be shut up until the grass is again ready, as at No. 1, for the fatting beasts.

By this expedient the fatting cattle will cull the choicest parts of the grass, and will advance rapidly towards a state of maturity, for they should always have a full bite of short and sweet grass; and, with such cattle, the

* This complaint of thistles is also common throughout Ireland. Mr. Weld states, in his recent Survey of the County of Roscommon, that "they are not only allowed to remain year after year in patches through the ground, but annually to increase and spread so as to become absolutely a plague to the land. These weeds are very commonly allowed as a perquisite to the herdsmen, who make some gain by burning them and selling the ashes: a custom as impolitic as can well be imagined; since so far from checking their growth, it is absolutely a bounty held out to their propagation.—p. 666.

† Parkinson on the English and Irish Practice of Agriculture, pp. 156—168. See, however, the Somersetshire Report, 3d edit. p. 175; in which it is stated that the graziers are fond of large inclosures, and object to the planting of any trees or hedges, as they prevent the free circulation of air, and harbour flies which tease the cattle. The same reasoning is also held by the greater part of the graziers in Ireland.—Weld's Survey of the County of Roscommon, p. 374.

greatest care should be taken not to over-stock the inclosures. It is also advisable to divide the fatting inclosure by hurdles, so as to confine the beasts within one half of it at a time, and to allow them the other half at the end of a week: thus alternately changing them from one division to the other, so that they may continually have fresh pasture. Shade, and pure water, are essentially necessary; and, where there are no trees, rubbing-posts should be set up to prevent the cattle from making that use of the gates and fences. In marsh land, which is chiefly divided by dykes, this, indeed, should never be neglected, as it is materially conducive to their comfort *.

Milch cows should likewise be treated in the same manner; and in dry seasons when the pasture has got too short, they should have the rowen of the meadows as soon as it springs; for not only will a great increase of milk be thus obtained, but land which has been long pastured gets foul, and the after-grass is apt to make the cows spring their milk. They should, therefore, be turned out to grass towards the end of April or the beginning of May, upon those grounds which are known to produce the most and the richest milk. In dairy farms such land is always pastured, without being ever mown, and contains a close and sweet herbage; for long over-grown grass gives a rank flavour to cheese. The inclosures for their use should also be chosen as near as possible to the homestead, for the driving of cows before milking, or the carrying of the milk to any considerable distance, is found to injure its quality †.

The hard or light stocking of pastures differs, as we have already seen, on mountain pastures, and on land of a richer quality it is also a point of dispute; some graziers contending that although by the practice of light-tocking much pasture is wasted, yet the animals thrive so much the better, that it leaves a greater profit than the opposite plan. Others, on the contrary, maintain that hard-stocking is indispensably requisite, particularly on rich soils, which, under any other management, would soon become overgrown with coarse and unprofitable grasses, and that to close-feeding, the Downs of Sussex, Wilts, and Dorsetshire are chiefly indebted for the sweetness of their bite, which depends more on the grass being kept down by the sheep as fast as it grows, than to any peculiar quality in the herbage. The latter opinion, certainly, has likewise in its favour the superior productiveness of the hard-stocked Lincolnshire pastures, and of Romney Marsh; in corroboration of which it may be also remarked, that, if a mixed stock be kept, not only the store cattle and lean sheep, but all cattle of different kinds and age, will eat a pasture close down if distributed in different inclosures in the manner already stated.

In every field numerous plants spontaneously spring up, some of which are disliked by one class of animals, while they are eaten by others; and some of which plants, though eaten with avidity at a particular period of their growth, are entirely rejected by the same beasts at another period of their age. Hence it becomes necessary, not only to have a great variety of cattle in the same pasture, but also a very minute attention is required to augment or diminish the proportion of some of these classes at certain times of the year; otherwise some part of the produce will run to waste unless it be hard-stocked to such a degree as to retard their thriving.

* It is maintained by some graziers that where large oxen are to be fatted no sheep ought to be depastured along with them. The more prevalent

* See the Complete Grazier, 6th edition, p. 74.

† Report of a Gloucestershire Vale Farm, No. iv. p. 28, in the Farmer's Series of the Library of Useful Knowledge.

opinion, however, seems to be, that a middle-sized ox, and a sheep or two, can be fattened with more profit, on the same space of land, than a large ox can be when grazed alone; and that two oxen and three sheep are a full stock for three acres of what may be generally called the very best land. On second-rate land, where the stock is intended to remain during the whole of the summer, four acres may perhaps be considered as the average required for the same number. Third-rate grass-land can only be employed with profit for young cattle and store sheep; and in all pastures it is well known that, where close sheep-grazing has been long practised, the herbage becomes finer than on those which have been also fed by oxen *.

There is an ancient practice respecting grass lands in some of the Welch counties,—provincially called *fogging*,—or keeping the land without stock from May or June to December, and in many instances to March,—which has been adopted with advantage in some other parts of the United Kingdom. The process, as detailed in the original reports of Cardiganshire and Pembrokeshire, is as follows:—

"As early in May as we can, the fields are shut up for the summer season, and continue in that state until November or December; when all the stock is turned in, and every animal is in excellent condition, without the aid of hay, straw, or oats, and the butter is as good as in any part of the year. The frost sweetens the grass, and snow does not injure it; but while it is buried, dry food must be resorted to. In the spring of the year young shoots of grass are very forward, under the shelter of the old, and both together are eaten with avidity. It has, indeed, been thought that the best acre of hay will not keep more stock, or in such good condition, as an acre of fog, with the additional advantage of avoiding the risk and saving the expense of haymaking and manure †.

"The stock is not, however, generally turned upon the land until February or March. By this practice, the farmer provides a good stock of keep for that season of the year when he stands most in need of it,—puts his cows into good plight for calving,—saves a great deal of hay,—and improves his grass lands by the quantity of seeds shed upon the surface by the fogged grass: his stock being out by day upon the fog, and in his straw-yard by night, augments his dung, which is the mainspring of his tillage management; and he gains, in a great measure, the advantages of a green winter crop ‡."

The practice of putting cattle from fogged-fields into the straw yard at night is so evidently advantageous, that, although it has been objected that the land is thus deprived of the manure, it ought never to be neglected, and, on farms which have a sufficiency of summer pasture, the precaution of leaving a portion under fog forms a sure resource against a scarcity of spring feed; but it has been observed in Lincolnshire, that where most grass is left in autumn, there the herbage in the next year is the coarsest and the worst, which accords with what we have said respecting the feeding of Romney Marsh.§ A writer of the first authority on this subject also remarks, "that the most profitable mode of consuming the produce as herbage of grass-land or of a pasture, or rather that mode which will insure

* Russell on Practical and Chemical Agriculture, p. 341.

† Lloyd's Cardiganshire, p. 17. On visiting this writer's demesne, some years after his death, it was stated by the tenant that a piece which had been fogged successively during sixteen years, was improving annually.—South Wales, Rep., vol. i. p. 545

‡ Hassall's Pembrokeshire, p. 36. This writer says, that "mossy pastures are benefitted by fogging;" and that "when land has been too long mowed, one year's fogging is supposed to recover it."

§ Lincolnshire Report, p. 221.

the least possible waste of the food, is to consume it as it reaches within bite of the stock; and consequently the farther it is permitted to advance in growth beyond this depth or age, so much more or less waste and loss are suffered."* He then estimates the amount of this waste by taking the quantity of reserved winter pasturage at one half the produce of the herbage, and the deterioration in quality from age, as well as the injuries by the feet and dung of the stock, at fully one-third; and if to this be added the less favourable effect upon the stock of consuming it in the field instead of the fold-yard, he considers the positive loss thus incurred as equal to one-half. On which it must however be observed, that this can only apply to cultivated farms which produce abundant root-crops; but when these are insufficient for the full support of the stock, the advantages of saving grass for the supply of winter food is essentially necessary to the maintenance of the cattle in condition. The land, however, should be of a dry and sound nature; for, if wet, the fog rots, and if too light, it dries up and withers before the season in which it is wanted arrives.

Fogging is to be distinguished from the *rowen* of ordinary husbandry, which consists in the aftermath, or second growth of grass, *after mowing*, and then preserved until winter or spring; whereas, fogging is effected by the sacrifice of the crop of hay—though, in some parts of the North, this second crop is called "fog." It should also be observed, that although the practice may be desirable upon farms which contain a large proportion of pasture, and may in some cases benefit the land, yet grass which is allowed to run to seed loses much of its natural sweetness, and is rendered coarser in the following year.

With regard to the *feeding of cattle* in the common management of pasturage, it may be observed generally, that those fields which are shut up from stock at Candlemas, may be grazed in the course of the following May: those which are fed until some time in April, and then closed again, may be grazed at Midsummer: while those to which rest is then given, may be grazed at Lammas; but if it be intended to pasture a field throughout the winter, it is proper to allow it to rest during the two last autumnal months.

MEADOW.

It has been remarked by writers on agriculture, that *natural meadows* are nowhere to be found; because all grass land which is in a state of nature, neither enclosed nor cultivated, is universally pasture. Many centuries probably elapsed before the invention of preserving grass by drying it into a state of hay; and this discovery, which gave rise to what we now term meadow, is supposed to have preceded that of tillage; though this may be considered somewhat doubtful, when we reflect that, in the primitive state of husbandry in this country, the cattle which were intended for consumption during the winter, were slaughtered in the latter end of autumn and salted for use. To such tracts of ground as consist of maiden earth, some persons are still disposed to limit the extent of meadow land; but, generally speaking, all land that is annually, or even occasionally, mown, is at present known under that denomination. Some considerable tracts of marsh have never yet been submitted to the plough, and much land, which, lying on the banks of rivers, is subject to be occasionally overflowed, is still in a virgin state; but by far the greater part of the upland meadow throughout the kingdom bears evident marks of having been anciently under cultivation.

* Sinclair on Winter Pasturage; Prize Essay of the Highland Soc. No. xx. p. 46.

The general *management of meadow land* lies in a narrow compass,—little diversified by practice, except when rendered necessary by difference of season and quality of soil. As the early vegetation of grass is promoted by taking the stock soon off the ground, the uplands are usually "hayned," or laid up at Candlemas; but richer land is often left open until the latter end of March; sometimes, indeed, particularly if the weather be moist, even later*: but, if continued too long, the hay-harvest is proportionably retarded and diminished. On this subject Mr. Sinclair has stated that a given space of the same quality of grass having been cut towards the end of March, and another space of equal size left uncut until the last week in April, the produce of each being afterwards taken at three different cuttings, that of the space last cut exceeded the former in the proportion of three to two; and in one instance during a dry summer, the last cropped space exceeded that which was cropped nearly as two to one.† On land of the latter description, care should also be taken to remove the heavy cattle early in the autumn; for such ground being commonly of a loamy nature, and soon softened by a fall of rain, would otherwise be poached, and it is well known that in wet weather the hooves of bullocks form holes which hold water, and thus render the herbage sour.

After the hay has been removed, the meadows are generally shut up for some weeks, until the grass again springs, when the stock are turned upon them in such proportion as they appear able to bear during the autumn; though light store stock are sometimes turned in immediately to crop such spots around the margins, and in the water furrows, as may have escaped the scythe. Other farmers, however, reserve it during winter, and then use it in the manner already stated in the preceding account of fogging. Some, also, who live in the neighbourhood of large towns, where they have the advantage of procuring manure, mow the land a second time some time in the month of August; but in that case they should be earlier than usual in the cutting of the first crop. Cowkeepers, indeed, frequently cut it two or three times in the summer, as they find that rowen hay is of a soft grassy quality, which occasions a greater flush of milk than that which is first mown, though it does not increase its richness, and they, therefore, cut the grass long before the seed has time to ripen. This frequent mowing, however, if it does not exhaust the soil, has a tendency to reduce the herbage‡: an injury to which new meadows are more exposed than such as are old; and, therefore, land recently laid down to grass, should not be mown, but pastured with sheep, or with very light stock, during the two first years, as the surer method of furnishing it with luxuriant herbage.

After the cattle are removed, the land is *bush-harrowed and rolled*. The bush-harrowing spreads those small portions of mould which are thrown upon the surface by the earth-worms, and are, so far, an excellent dressing, when the operation is properly performed. This, however, is most commonly done by interweaving some strong, but pliant, branches of trees, or hedge-row thorns, through the open squares of a heavy harrow, which thus forms an efficient brush, and when drawn over the ground performs its duty perfectly during a short distance; but the branches being

* Land of this description has been spring-fed till the 12th of May, and has afterwards—when mown on the 24th of June—yielded two tons of hay per acre.—Somerset Rep., 3d edition, p. 179.

† Hort. Gram. Woburn.; 3d edit. p. 389.

‡ In the Berkshire Report it is, however, said that—"the grass being cut when very young, the land is less exhausted, though frequently cut thrice, than with us, where it remains on the ground before mowing, till a considerable number of the plants have ripened their seeds."—p. 296.

pressed close, and worn by the motion, soon become so flat as not to have the effect of spreading the earth. The better mode is, therefore, to fix the branches upright in a frame placed in the front part of the carriage of the roller; by which means they can be so placed as to sweep the ground effectually, and when worn can be moved a little lower down, so as to continue the work with regularity. In this manner the bush-harrow can also be drawn by a single horse and driven by one man, instead of employing two horses and two drivers, as is the case when the land is rolled and harrowed separately. The object of rolling is merely to lay the land as smooth as possible for the convenience of the mowers, for it is thought by many farmers to retard the progress of vegetation; though there can be little doubt, that if the soil is porous and spongy, the roll will add to its firmness, and give a more substantial bottom to the sward. It has, indeed, been stated, that the operation of heavy rolling has been found to add six or seven hundred weight of hay per acre to the produce of the crop*.

It is also generally thought proper to *destroy the moles* which sometimes burrow in meadow ground, for they raise hills which impede the operation of the scythe, and we shall, therefore, furnish directions for that purpose, under the head of vermin: but it has been lately much doubted whether the mischief which those animals do to pasture land, is not more than counterbalanced,—particularly on sheep pasture,—by the benefit derived from the top-dressing thus thrown up.

Land that is constantly mown must also be frequently manured, or it will be thrown out of heart. This, however, is very imperfectly attended to by most of those farmers whose holdings consist chiefly of arable land; but grass farmers are well aware that if they do not lay a good coating of rotten dung upon the ground once within three or four years, they will have but a slender crop of hay, even if the after-grass be all pastured. It is, indeed, supposed that a perfectly thick bottom cannot be maintained upon such land, unless it is manured every second year, and therefore many of the farmers in Middlesex covenant to mow only once in each year, and to spread on the land a full coat of stable dung, thoroughly rotten, every third year, and this management has been found to support the soil in good heart †. If the weather proves moist, or inclinable to rain, it is usually laid on immediately after the removal of the hay crop; but if the season is dry, the operation is then deferred until some time in the autumn, or, more frequently, until early in the spring.

Water-meadow will be considered under the separate head of Irrigation.

Chapter XXXII.

ON HAYMAKING.

The time of mowing and the mode of making hay of the different grasses —both natural and artificial—vary not only according to the state of the weather and the practice of separate districts, but also according to the uses to which the hay is intended to be applied; for, although all appropriated to the feeding of cattle, it yet differs in its estimation for the various kinds of stock; that of clover, sainfoin, and tares being chiefly

* Derbyshire Report, vol. ii. p. 188.

† Survey of Middlesex, 2nd edition, p. 287.

employed for beasts of heavy draught and the common purposes of the farm, while that of natural meadow grass is preferred for milch cows and saddle-horses. Thus, in the vicinity of large towns, where the colour and softness of hay is more thought of by the generality of consumers than its nutritive properties, it is mown early, and got into stack in as green a state as may be thought prudent; while those farmers who expend it in the support of their own stock, are more careless in this respect, cut it later, and leave it longer in the field. In some places, indeed, and more particularly in Ireland, this is carried to so objectionable a length by anxiety to procure as large a crop as possible, that it is by no means unusual to see the harvest of meadow hay so late as the middle of August, and left standing in the rick-yard, or *haggard*, as it is there called, until long after that time, whereby the crop is considerably injured in quality, and the intention of increase in the quantity is very commonly foiled through the drying effects of the atmosphere. This mode of making is, however, justified by some of the farmers in the latter country as being the necessary consequence of the superior richness of the grass, which, if not thus treated, would be exposed, by its great fermentation, to catch fire*; for which there may be some foundation upon strong soils, but it can form no excuse for the generality of the practice, and it may in all cases be rendered less requisite by additional turning, or by making the stacks smaller. The lateness of the crop in some parts of England is accounted for by the general coldness of the spring on the Eastern coast, which compels them to feed their mowing grounds late†. It is also thought by some persons that if the seeds of the grass be left to ripen, the hay will afford a greater quantity of nutritive matter than if cut when in flower; but the value of the aftermath thus lost is often greater than the extra nutriment gained, for the ripening of the seeds not only weakens the future growth of the plants, but the aftergrass has not sufficient time to acquire strength. Mr. Sinclair states that he has in many instances found it reduced to less than one-half in a given time after the seed crop than when cut at the time of flowering; but he adds, that he could never observe its bad effects to extend in any degree to the following season ‡.

TIME OF MOWING.

It has been observed by the late Dr. Darwin, that while the flowering stems of grass are shooting up, and during the whole process of fructification, every species of grass—but more especially those known by botanists under the designation of the tribes of *Poa* and *Festuca*—abounds with saccharine matter. This, according to his idea, is found particularly in the joints of the grasses, where a secretion of sugar takes place, and it is

* See the County Surveys of Ireland generally; Lambert's Observations on the Rural Affairs of Ireland, p. 42; and Parkinson on the Management of a Farm in Ireland, p. 109. The latter writer says that "it is a custom in that country to make what is termed *tramp-cocks* (or *lap-cocks*) of hay, and to let it stand on the ground for some months, in reality until it has smothered the sward in such a manner as to destroy all the grass roots on that spot of ground; a custom that, besides, occasions a great loss of hay, by the steddle or bottom part becoming mouldy, and some of it rotting: neither does the evil end here; for when the hay has stood so long in these large cocks, the first sweat is got over, so that when it is stacked the air penetrates into it, and it acquires a sort of fusty smell, thus losing all the sweetness required in hay. The hay which was on the farm when he entered did not fatten cattle in the same proportion as he had been used to the hay doing in England, and he is certain that this was to be attributed to its being put up in the manner described." See also Darwin's Phytologia, p. 77.

† Lincolnsh. Rep., p. 223.

‡ Hort. Gram. Woburn., p. 215.

probable that from this source the subsequent nutriment afforded by the plant is in great measure derived. As the seeds approach maturity, this sugar is found in less abundance; and when they are completely ripe, the object of nature being attained, the stem and leaves begin to decay.

The proper time for cutting the meadow grasses seems, therefore, to be when those saccharine juices are in the greatest abundance; which appears to be when the seed is formed, but before it has arrived at maturity, for if it be allowed to grow thoroughly ripe, not only will a nutritive portion of the plant be wasted, but the land will become more exhausted than if the crop had been cut earlier. It has, indeed, been proved by experiments carefully made upon many kinds of herbage, at different periods of their growth, that plants of all sorts, if cut when in full vigour, and afterwards carefully dried without any waste of their nutritive juices, contain nearly double the quantity of nutritive matter which they do when allowed to attain their full growth and make some progress towards decay. It is, however, the opinion of many experienced farmers that the grass should be cut as soon as the first flowers blow; for at that period it contains all the useful qualities of which it is susceptible, and afterwards becomes daily more tough and sapless. Such is certainly the practice in Middlesex, which is celebrated for the quality of its hay, though probably that depends more on the estimation accorded in the London market to its colour and fragrance, than to its real nutritive properties. If the cutting of the crop be much protracted, the best season for making the hay may also be passed; the plants become withered at the bottom of their stems; the roots are injured; and the aftermath is materially lessened in quantity. These remarks, therefore, suggest the propriety of watching the progress of the bents of the early grasses to perfection, and of cutting the crop before they drop their seeds, although the sward of those of later growth may not then be ripe.

Upland meadows, if well manured, will in general be ready for mowing by the middle of June, or even earlier if the summer be favourable, and never should be left standing longer than July, unless prevented by a continuance of wet weather. The first crops of the artificial grasses are always cut earlier.

MODE OF MAKING.

There are but few departments of a farmer's business which demand more arduous care than this; for the weather can never be depended upon, and if security could be obtained on that point, the most vigilant circumspection is requisite to insure the due performance of the work, for all countries abound in bad haymakers; quantities of hay are annually wasted, and still greater quantities unnecessarily injured, through bad management. *Mowing* is indeed usually done by the acre, but *making*—as the tedding, raking, and remainder of the process is usually termed—is paid for by the day's work, and from the number of hands employed including persons of both sexes and all descriptions, is necessarily entrusted to people who frequently understand nothing about it, and who, if not sharply looked after, idle away half their time

In the southern counties it is generally calculated that an expert mower performs a good day's work when he cuts an acre, if the crop be heavy—if light he will do more; but in the north the labour is performed by the strongest men, who use a scythe that is considerably longer—being commonly about five feet in length—and who usually cut an acre and a half. In the execution of the work they generally point both in and out, by which means few or no balks are left, and from the great breadth of the

swaths, and the close manner in which the grass is mown, their labour is very severe: they have, however, an allowance of strong beer, which is not usually given to other labourers. This mode of cutting is, indeed, in every point of view, advantageous, for the closer and the more level the grass is mown, the better will the after-grass thrive, and the saving of hay is considerable, for one inch at the bottom weighs more than two at the top; but it requires a very experienced mower to perform it well. Farmers should, therefore, be more cautious than they generally are in the choice of mowers: in their own neighbourhood, indeed, there can be no difficulty, for there every man's capability is known, but when strangers are employed much loss is frequently sustained by their incapacity and carelessness.

Mowing commences at the earliest dawn of day, while the dew is upon the ground, and when the grass is down, if the weather be favourable, the swaths should be opened with forks, and evenly spread over the meadow, during the same morning if it be cut early; but that operation is very commonly, though improperly, deferred until the next day, when the upper surface having become somewhat brown and withered, they are turned over as soon as the dew is off. If the weather continue hot, the swaths should however be immediately shaken out and tedded, or thrown about once or twice in the course of the same day, by which means the hay will be cured in the least possible time, and its colour and essential juices will be more effectually retained than if it be long exposed in the same position to the sun. It should then be gathered with rakes by people working in contrary directions, into long narrow rows, called "wind-rows," and afterwards, with forks, into small "cocklets," or "foot-cocks," and left during the night, for it should be guarded as much as possible from the dew. On the following day, it must be again thrown out to the air, and if then judged sufficiently dry, it should be brought together late in the evening in larger cocks, after which it may carried, on the third day, without any further process, to the stack. In short, the chief points to be observed are, always to preserve the hay as much as possible from dew and rain; therefore, to bring it into wind-rows, if not to cock it at nightfall; never to open it in the morning till the dew has evaporated; and not to allow it to remain too long under the scorching heat of the sun without being turned. The degree to which hay requires to be dried depends on its quality; coarse hay should be allowed to heat more in the stack, and therefore should be less made than that of fine succulent herbage

The Middlesex practice will be found detailed at foot*. That of

* *First day.*—All the grass mown before nine o'clock in the morning is tedded, in which great care is taken to shake it out of every lump, and to strew it evenly over the ground; for by this regular method of tedding the hay heats more equally in the stack, and is consequently not so liable to damage. Soon afterwards it is turned, with the same degree of care and attention; and if, from the number of hands, they are able to turn the whole again, they do so, or at least as much of it as they can, till twelve or one o'clock, at which time they dine. The first thing to be done after dinner is to rake it into what are called *single wind-rows;* that is, they all rake in such a manner as that each person makes a row, which rows are three or four feet apart; and the last operation of this day is to put it into grass-cocks.

Second day.—The business commences with tedding all the grass that was mown the first day *after* nine o'clock, and all that was mown this day before nine o'clock. Next, the grass-cocks are to be well shaken out into staddles (or separate flats) of five or six yards diameter. If the crop should be so thin and light as to leave the spaces between these staddles rather large, such spaces must be immediately raked clean, and the rakings mixed with the other hay, in order to its all drying of an uniform colour. The next business is to turn the staddles, and after that to turn the grass that was tedded in the first part of the morning once or twice in the manner described for the first day. This should all be done before twelve or one o'clock, so that the whole may lie to dry

Wensley Dale, and other parts of Yorkshire, with some of the northern counties, is to cut the grass as low as possible, and on the following day, to strew it evenly and lightly with the hands; for in this part of the work they use neither forks nor rakes, unless the grass should be very light. In that condition it is allowed to remain until the day after, when it is turned with the rake-head, and is before noon raked into small rows, called "turnings;" the haymakers beginning at the side of the field farthest from the wind; and in the evening of the same day, the rows are made into small "hay-cocks. The next morning, as soon as the dew is well evaporated, the cocks are spread carefully abroad by hand, and again before noon brought into rows. In this state, if the weather has been perfectly fine, and the quantity to be stacked in one rick is not large, it may be carried, or otherwise it is made into large cocks, and allowed to stand a few days to be lightly fermented; though not so long as to allow the base of the cock to become injured by the moisture of the ground *.

The plan recommended by Dr. Anderson and others, is—not to cut the grass until it is perfectly dry, when the swaths having had the sun for a few hours, are to be made into small cocks in a pointed shape, as narrow at the base as possible; to remain in that state during one or two weeks, according to the weather, and then to be put into larger, or "tramp-cocks," in which, after remaining a few days, the hay will be fit to stack. The benefits resulting from this practice are stated to be a considerable reduction of labour, and that the hay continues nearly as green as when it was first cut, also containing its natural sap in the greatest perfection; whereas by tedding and managing in the usual manner, its juices are exhaled, and it is more subject to become injured by rain †. Although this may be true if the weather be fine, and the hay perfectly dry when first put into cock; yet as both these conditions can rarely be attained, we do not consider this mode of making hay as generally likely to succeed. Perhaps, however, a medium between this method, and that which we have previously recommended, may be safely adopted by those who are scanty of hands, which is—not to tedd the grass so much as there described; to draw it into windrows instead of cocking it every evening, and only to open and shake

while the workpeople are at dinner. After dinner, the first thing to be done is to rake the staddles into *double wind-rows*, which are six or eight feet distant from each other; next, to take the *grass* into single wind-rows; then the double wind-rows are put into bastard-cocks; and lastly, the single wind-rows are put into grass-cocks. This completes the work of the second day.

Third day.—The grass mown and not spread on the second day, and also that mown in the early part of this day, is first to be tedded in the morning, and then the grass-cocks are to be spread into staddles, as before, and the bastard-cocks into staddles of less extent. These lesser staddles, though last spread, are first turned, then those which were in grass-cocks, and next the grass is turned once or twice before twelve or one o'clock, when the people go to dinner, as usual. If the weather has proved sunny and fine, the hay which was last night in bastard-cocks will this afternoon be in a proper state to be carried; but if the weather should, on the contrary, have been cool and cloudy, no part of it probably will be fit to carry. In that case, the first thing to be set about after dinner is to rake that which was in grass-cocks last night into double wind-rows; then the grass which was this morning spread from the swaths into single wind-rows. After this, the hay which was spread last night in bastard-cocks is made up into full-sized cocks, and care taken to rake the hay up clean, and also to put the rakings upon the top of each cock. Next, the double wind-rows are put into bastard-cocks, and the single wind-rows into grass-cocks, as on the preceding day.

Fourth day.—On this day the great cocks just mentioned are usually carried before dinner. The other operations of the day are such, and in the same order, as before described, being continued daily till the hay-harvest is completed.

* Tuke's Survey of the North Riding of Yorkshire, p. 174; Communications to the Board of Agriculture, vol. vii., part 1.

† See the Complete Grazier, 6th edit., p. 150, and Anderson's Ess. on Agr.

it out for a few hours in the middle of the day; then, to make it up in the last stage into very large cocks, slightly thatched by having a little of the coarsest grass laid upon the top with the ends downwards; to remain one whole day or two, according to the weather, and then to be carried. In this manner the labour is lessened; the want of making is supplied by the partial heating of the grass in the large cocks; and under the circumstances in which many farmers are often placed, the plan has been found to answer every useful purpose. Although we state this upon the authority of a very experienced and intelligent farmer, yet it must be recollected that it is a plan which we only advocate in cases of necessity *.

Such are the modes most usually adopted; but when the weather is unfavourable, a less direct and more laborious method becomes necessary. The chief aim, then, being to secure the making of the hay with the least possible risk, the grass, after being mown, is not tedded out, but often remains for a couple of days, or even more, in the swath before it is touched; yet if a dry moment does not occur for turning it, that operation must still be performed before it has time to become yellow underneath, and particular care should be taken to turn the swaths with the heads of the rakes. After being thus dried, it must be again turned over, tedded, brought into wind-rows with the rake, and put into cocks, which are afterwards shaken out, if the weather permits, or nicely turned upside down, and then made into larger cocks, which if formed into a conical shape will stand a considerable quantity of rain without injury, until they can be got sufficiently dry to be put into stack without heating †. An expedient is also practised in Yorkshire to get the hay out of harm's way, when not sufficiently dry to be regularly put into stack, which consists in putting it into "pikes" or "stacklets" of about a load each. This is done by passing a rope round the bottom of each cock, and drawing them by horses, so that ten or twelve may be formed into one pike, and either left in the field or carried upon sledges into the rick-yard, and there placed in larger pikes around the site of the intended stack. If well managed, these will not be materially injured by rain, and a slight fermentation commences which, in favourable weather, prevents too much heating when put into the stack ‡. Marshall, however, says, "that it is more generally made use of as a slovenly expedient for getting the hay out of hand in a tedious season; and that he has seen these pikes when opened out to be carried to the stack, white with mould, black with rottenness, and of every intermediate colour, excepting that which is alone desirable §."

In the *making of rowen hay* more attention is necessary than in taking the first crop, from the greater difficulty of mowing occasioned by the lightness of the grass; so that, unless the mowers are very expert in the management of the scythe, it is apt to pass over the herbage without cutting it. This operation should therefore be performed very early in the morning, while the dew is upon the ground; but the subsequent management varies in no respect from that pursued with regard to the first crop. It is, however, fraught with considerable risk, for the grass is more soft and succulent at this period of the year, consisting almost solely of leaves without stem or stalk, and consequently requiring more time to dry up the juices: whilst at this season the dews are generally heavy, and lie long upon the ground; so that, even if the weather be favourable, but a short

* See Batchelor's Survey of Bedfordshire, p. 443.

† Lancashire Report, chap. viii. section 1. Cheshire Report, chap. viii. section 3.

‡ Report of Select Farms, in the Library of Useful Knowledge; No. v. p. 12.

§ Rural Economy of Yorkshire, vol. ii. p. 135.

time occurs during which it can be freely exposed to the sun and the air, and a very small quantity of rain will have the effect of rendering it mildewed or mouldy. It is, notwithstanding, frequently cut from water-meadows for the use of cows; but it is inferior to the hay of upland meadow for the grass not having had sufficient time or sun to give it firmness and consistence, has no proof in it, and though relished by all cattle, yet fatting stock do not thrive on it.

Clover and other artificial grasses are usually mown when the heads appear in full blossom; but rather sooner than later, as the error of cutting the first crop too early is fully compensated by the increase of the second. The proper time may be ascertained by observing the bottom of the plants; and care should be taken to mow it when the lowest leaves begin to show symptoms of decay, for if the crop be suffered to stand longer, it will lose more at the bottom than it would gain at the top. The period of this state of ripeness depends both on the season and on the condition of the land; but in common years, and on ground in good heart, it generally occurs, for clover, about the first or second week of June, and if not then cut down, it has been found to suffer more injury than if it had been cut in an early state. *Sainfoin* is ready for the scythe rather earlier. The sooner it is cut after the blossoms make their appearance, the better will be the quality of the hay, although the quantity may not be so great; for, if allowed to stand until they all come out, the stems which first flower grow tough, and the hay thus becomes coarse and unpalatable. One load and a half, when cut out of the stack, may be considered a fair average crop of either.

An expert mower will, in the north, cut full two acres of sainfoin per day; of clover rather less; but in the southern counties, the average does not exceed an acre and a half of either, and the work must of course depend upon the richness of the crop, for sometimes the one, and sometimes the other, may be the heaviest. As the weather is at that season usually fine, and the sainfoin is naturally dry and open, the making of it into hay is attended with but little difficulty: clover, being more succulent, requires greater care, and more time to dissipate its juices, as it is otherwise very subject to heat in the stack, and, if not to become mouldy, at least to be discoloured. When mown, the swaths should not be spread out, as is the practice with meadow hay, (as the plants are delicate, and easily lose their leaves, either by being shaken about, or by being much exposed to moisture,) but suffered to lie as the scythe leaves them, until they are nearly dried, which will generally be in two or three days. Then they should be gently turned over with the rake immediately after the dew is off; and, if no rain falls, the hay will be fit to cock on the following morning, and may be carried in on the fourth day.

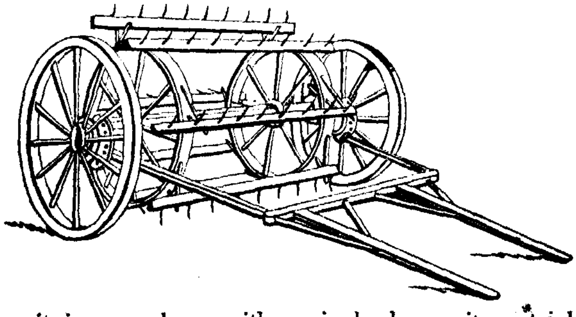
When the clover is cocked as soon as the dew is off, the leaves will be just sufficiently tough to preserve them; but if this be omitted in the morning, and performed in the heat of the day, the leaves will have become so dry as to be partly reduced to dust, and lost in the operations of loading and stacking; although, if it has been mown sufficiently early, this is not so apt to occur, and the loading and stacking may then be continued all day without interruption. If, however, it should become too dry to be carried without some risk of loss, this may in some measure be prevented by lightly rolling the swaths over with rather larger forks than usual, keeping the load closely together, and being careful, when laying it into the cock, to avoid breaking and tossing it about, or beating it down *.

* Middlesex Report, second edition, p. 297.

The above is considered the most advisable mode of making clover hay, though many persons, after turning it in the swaths until nearly dry, put it up into small cocks, in which it is allowed to stand for three days; after which, advantage is taken of a brisk drying day to spread it out, and in the morning to lay it in cocks of about half a ton each, in which state they remain until removed to the stack*. The making of the other artificial grasses into hay so nearly resembles this practice, that any particular statement of the modes employed with regard to *tares*, *rye-grass*, or *lucerne*, is unnecessary: they are, indeed, more generally used, in a green state, for soiling; but as they are all subject to material injury from rain, the state of the weather should be watched before they are cut, and every care and activity should be employed to get them promptly into stack.

The common number of workpeople is five hay-makers to each mower, including tedders, loaders, pitchers, and stackers; but exclusive of the carters who drive the teams employed in carrying the hay. There are, therefore, frequently more than twenty persons engaged in the same field; and as some management is necessary to keep them in order, a steady experienced old fellow should always be placed at their head for that purpose; for it is impossible that the farmer should himself afford that constant attendance which is requisite to the direction of each operation, and the man who would cure his hay at the most moderate expense and with the least possible risk of losing the season, must urge those who make it, those who load and carry it, and those who stack it, to make the most of every hour and secure it while the sun shines. Every part of the operation is done with forks and rakes, and every hay-maker is expected to bring an implement of each kind; but the farmer is most frequently obliged to find both.

A machine for the *spreading of hay* after the scythe was some years ago invented in Yorkshire, and has since, with some improvements, been pretty generally adopted. It is of the following form,—and we have



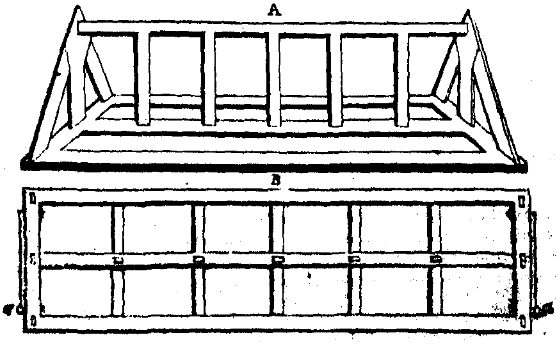
lately seen it in use where, with a single horse, it certainly turned

* Report of the East Riding of Yorkshire, p. 171. A mode has been also sometimes adopted in Lancashire, and attended with success. It consists in collecting the clover together into small portions, immediately after it is mown, in a manner somewhat similar to sheaves of grain, and kept straight; then twisted together in the top, so as to admit of their standing on their bottom, when a little spread out; something in the same way as horse-beans are placed. In this state they are left; and if not thrown down by the winds, they will resist more rain than when lying upon the ground: or, if the weather be fine, the clover, having more extent of surface exposed, is said to become fully made in a very short time. Dickson's Lancashire, p. 504. This method, however, though it may partially secure the hay from damage by rain, would in fine weather have the effect of drying it unequally; the outsides of those sheaves being too much and the interior part insufficiently exposed to the sun; whereas the true principle of hay-making is to dry every particle alike.

and tedded the hay more effectually than it could be done by hand, performing with ease the work of fifteen tedders, and it is said to turn the grass of thirty acres in a day. It spreads the grass lightly and equally over the ground, and divides the swaths with great minuteness and rapidity, performing its work in the best manner when the horse trots at a gentle pace. To avoid straining and clogging up the machine, it is, however, necessary to avoid short turns; and when the wind is high, and the hay tolerably dry, a course must be taken so as to turn it always on the leeward side; otherwise, when going before the wind, the hay would be blown over the machine, instead of being left behind it. Still, it does not occasion that saving of labour which might be supposed, for it does not rake the grass into rows, nor cock it; and when the grass begins to get dry, the violence of its operation is apt to shake out the seed: its chief use, therefore, seems to be upon heavy crops, and in catching weather it may be found of essential service. It, however, is only calculated to act upon level ground, and is a rather expensive implement; for the charge of the manufacturers in London is 18*l.*, though we learn that its original cost in Yorkshire was only 4*l.**

Besides the light rakes of the common description, with wooden teeth, there are also some of a larger form, called "ell-rakes," with curved iron teeth, which are used for the final collection of the crop into large cocks; but a *horse-rake*, of a simple construction, which could perform the work with fewer hands, is an instrument much wanted, and if formed upon the same principle as the stubble-rake that is in use upon many arable farms in various parts of the kingdom, would occasion a further saving of time and labour. An improved implement of this kind has been lately brought from North America, and has, we understand, been successfully employed in some parts of Scotland. It is drawn by one horse, and is said to be equal to the labour of twenty persons with common rakes; but the description given of it in the Transactions of the Highland Society is so very minute, as well as confused, that we must refer to that publication for the particulars †.

In several parts of this kingdom and in Ireland, *hay-sweeps* are used for readily collecting the hay together when raked into rows, and intended to be stacked in the field. They are usually in the form of a sledge, and are in some respects more convenient and expeditious than waggons; that commonly used in Yorkshire, is drawn by two horses, and is formed as in the annexed cut—



* Report of Select Farms, in the Library of Useful Knowledge, No. v. p. 4.
† New Series, vol. [illegible]

A being a perspective view of the machine, and B the frame of the bottom, the upper part of which is boarded. *a a* are two pieces of iron fixed on the frame with nuts and screws; on each side is a ring, to which the horses are fastened, one horse going on each side of the row, whilst the sledge has got sufficiently loaded, when one horse crosses the row, and the load is taken to the stack. When arrived, the horses are turned about, and the rings run on the other end of the irons; the sweep is then drawn back, leaving its load, and proceeds to collect another*. This implement, it will be perceived, is equally simple and unexpensive, for it can be made for less than 50*s.*; and it has been suggested, that if a row of teeth was added to each front, it might also be made to act as a rake.

In some very steep and small inclosures, hay is also sometimes carried by a method, in Derbyshire, called *stanging;* a stang signifying a pole, two of which being laid upon the ground at two and a half or three feet apart, and a large cock of hay being laid upon the middles of them, two men take it up by the ends of the poles, in the manner of sedan chairmen, and thus carry it to the side of the stack†.

STACKING.

Great caution is requisite in the *stacking of hay;* for, if not put together perfectly dry, it is liable to ferment, and from this being exposed to catch fire, whole stacks have been not unfrequently reduced to ashes. *Haystacks* are generally made of an oblong form, as the hay can thus be more accurately cut into square trusses than when the stack is round. The ground upon which they are built should be either raised with stones and hard compost, or with chalk, to secure the bottom from wet; or a sill of stout timber, with the bark on, should be laid down of the exact size of the stack, and afterwards filled up with faggots or with furze, covered with hurdles, for a floor. The former is the preferable plan, because it prevents rats from nestling under the staddles; but in that which is the most commonly adopted, a bottom is merely laid of faggots and irregular billets of wood without any frame. They are erected of any size that may suit the convenience or the fancy of the owner; but those of moderate dimensions—say about 30 feet long by 12 broad at the bottom, and reckoning 9 or 10 feet in height to the eaves—are the most sightly, the least exposed to accident by heating, and will contain about 20 loads. Farmers, however, generally prefer those which contain double that quantity, both because there is less expense in thatching, and less proportion of exposed surface: the outsides always becoming dusty and inferior to the hay which is in the interior. The ricks should stand parallel to each other, at least 10 or 12 feet asunder, that carts may have room to pass between them, as well as to keep a free circulation of air in all directions; and while forming they should be always covered with rick-cloths supported by poles, to guard them from wet, in the manner which will appear in the next volume under the head of harvest.

In *forming the stacks*, a layer of haulm, or straw, is usually laid over the staddle, and the hay is then regularly spread and even trodden down, keeping the middle rather higher than the sides. In this manner it is carried evenly up to a few feet in height, and is then made to project gradually outwards up to the eaves, so as to overhang the sides, as it is thus more effectually secured against rain. The roof is then raised to a con-

* North-Riding Report, p. 88.
† Derbyshire Report, vol. ii. p. 180.

siderable height, in a slanting form, with gable ends, and this part of the operation requires considerable care and experience in the building up of the rick. Being thus formed, the bents and blades which project outwards are pulled by hand, until the surface presents a smooth and regular appearance, and these pullings are used to top up the stack; which, after being allowed a few days to settle, is then thatched with wetted wheat or rye straw, by men who make that a business. In effecting this part of the operation, care should, however, be taken to prevent the thatchers from laying on the straw in too wet a state; for it will then injure the hay for several inches downwards. The common charge for labour is from 1*s*. to 1*s*. 3*d*. per 100 square feet; the smaller stacks being charged higher than those of large dimensions. The quantity of straw thus used in a stack containing forty loads of hay will be about two loads of straw, and more in proportion if the stack be smaller.

Stacks are also not unfrequently formed, when of small size, quite round; and sometimes with gable ends, not too high, nor yet like a house-roof in the form of a triangle—but rather circular; in which shape they are much less liable to admit of rain passing through the thatch, and a smaller quantity of straw suffices for that purpose.

It is the custom of many farmers to *ventilate the hay stacks* by means of funnels in their interior, in order to prevent the hay from becoming mow-burnt, by drawing off the hot vapour occasioned by fermentation, and various methods are adopted to effect that purpose; such as square troughs bored full of holes, or nailed together with laths, or with sacks full of straw, which are placed upright, and the hay trod round them as the making of the stack proceeds, until the sack is nearly buried, when it is drawn up a little, and the hay laid round it as before. The advantages supposed to be thus gained are, however, counteracted by the parts on every side of such vents becoming mouldy, unless a free thoroughfare be secured for the air underneath; and in case of a current being thus admitted into the stack, it then greatly increases the risk of fire. It is, therefore, justly reprobated by every skilful haymaker, and should only be resorted to when occasioned by wet weather; in which case the danger may be partly prevented by mixing the hay with layers of straw.

It is well known that a moderate degree of fermentation, or *sweating of hay in the stack*, has the effect of communicating a flavour to it which,—as exemplified in the difference between old and new hay,—not only renders it more really nutritious and wholesome, but certainly makes it more palatable to the cattle which are fed upon it than such as has never gone through that operation; and the greater the quantity of sap which can be retained in the hay without endangering its being fired, or becoming mow-burnt, the more perceptible will be the fragrance of that flavour. The time of getting the hay into stack, therefore, requires considerable judgment, and depends not alone upon the state of the weather, but also upon the condition and quality of the crop. In the present parching summer we have seen some scanty crops carried off the meadows, and stacked without risk on the second day after they had been cut; for although this might have been attended with danger had the grass been succulent and weighty, yet if light crops, or those produced upon a poor or unmanured soil, were to be long exposed to the action of the sun and air, their juices would be dried up, and they would lose both in their weight and in their nutritive value. The process of drying may, therefore, be continued too long; or it may, on the contrary, be not carried far enough. Accidents

of the latter kind not unfrequently happen to rich crops in fine sunny weather, which by drying the surface gives a withered appearance to the grass, and leads to the supposition that it is in a state fit to be stacked; but, the evaporation being only external, and too much of the sap being thus retained, the fermentation in the rick becomes too great, and if it should escape being fired, it at least loses much of its fragrant smell, acquires a dark brown colour which increases towards the centre, and thus becomes what is termed *mow-burnt*,—which is said to weaken horses that eat it, by promoting an excess of urine. In like manner, hay which has been put into stack in a damp state, besides being exposed to the same risk, is also subject to become *mouldy*,—in which condition nothing but extreme hunger will compel cattle to eat it; but if neither mow-burnt, nor mouldy, farmers do not object to the colour being somewhat brown, as they consider it a proof of the nutritive properties of the hay.

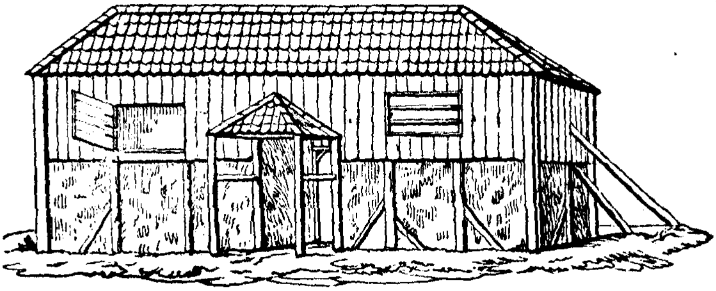
On what we have formerly stated in recommendation of the *application of salt* in the stacking of all kinds of hay, when coarse, or injured by the wet of an unfavourable season, it has been remarked, that if it be put into the stack wet, and rainy weather follow immediately, it must increase the dampness, as it is a well-established fact that salt attracts the moisture of the atmosphere, and, therefore, must increase the risk of fermentation *. On which we have only to observe, that, although that theory is contradicted by experience, which shows that the attraction of the salt acts upon the moisture of hay instead of that on the atmosphere, and thus checks fermentation; yet our observations did not extend to hay which was absolutely wet, but to that which is in such a state of dampness as to render it liable to become musty; and if it be merely coarse, or sapless through repeated changes of the weather, the effect of about 14 lbs. of fine salt sifted regularly through each ton of hay, when it is put into the stack, will certainly improve its quality, although it may injure its colour †.

Hay barns possess the decided advantage of not only forming a secure receptacle for the hay, but also affording considerable convenience during catching weather in carrying small quantities at a time as soon as it is ready, as well as in unloading the waggons under cover, when it could not be done with safety in an exposed yard, and thus ensure employment for hands which might otherwise remain idle. In winter they also admit of the hay being cut out of stack, weighed, and bound, in perfect safety, which could not sometimes be done out of doors, either with regard to the security of the crop, or the comfort of the people employed in preparing it for market. It is likewise the opinion of many farmers that hay may be put together earlier, even by a day, than it would be safe to do it in a stack. The expense of thatching hay, especially in the neighbourhood of large towns where straw is dear, amounts in common seasons to about 2*s*., and in some cases 2*s*. 6*d*. per load; though from that is to be deducted the value of the straw as litter when the stack is cut: in hay-barns this charge is avoided; and as there is a further saving occasioned by the facility of loading the hay, and afterwards of cutting it for market under cover, these sums have, in wet seasons, amounted to something considerable. Mr. Middleton, the well-known author of the "Middlesex Survey," erected one capable of containing one hundred loads of hay upon oak posts, in a most complete

* See Chapter xviii. p. 385.

† On this subject, see most of the County Surveys, in some of which double that quantity is recommended; also, the Treatise on the Horse, published in the Farmer's Series of the Library of Useful Knowledge, p. 367.

manner, at West Barnes farm, in Surrey, where he resided during many years, and he says, that the savings equalled its cost in two years: but this was aided by the then high price of straw. With this building we are well acquainted, and we can vouch that it contains all the conveniences already stated; nor, although the land is highly manured, and the hay produced upon the farm is of excellent quality, has there ever been an instance of its being too much heated. The roof is tiled, and it is boarded to some distance below the eaves: the entrance being in the centre, it forms two large bays for the reception of the crop, and affords complete shelter to a couple of waggons.



We must, however, admit that hay stacked in the same yard cuts out of the rick in rather finer order than that in the barn; and although the difference is not so great as to affect its price, it is yet preferred by those who are acquainted with the circumstance. It is difficult to account for this, for the hay is in both cases equally open to the air, and that in the barn is put together in larger quantities than that which is stacked, consequently ought to be closer, and to sweat with more effect; yet the contrary is the fact, and the same observation has been made by many farmers with whom we are acquainted. The barn is however roofed with tiles, which do not form a roof so impenetrable to the air as one of thatch; neither can the hay be packed so close to the roof; thus its sweating is partially prevented, and to this the defect may probably be attributed.

Grass, when dried into hay, loses about three-fourths of its weight: 400 tons in the field consequently yield only 100 when put into stack; by the process of heat and evaporation it is supposed to be still further reduced about ten per cent. in the course of the year; and if cut for sale during the summer months, the operations of cutting, trussing, and carrying to market render it so much lighter, by exposure to the sun and wind, that it probably loses from five to ten per cent. more. During the winter this latter species of waste will be avoided, and from this circumstance, together with others which relate to price and conveyance, farmers who do not consume their hay upon the premises, may determine the season at which it will be most advisable to dispose of the crop. Upon good land, a load and a half of meadow-hay is thought a good average: in fine seasons, and with plenty of manure, two loads are frequently made; but three loads, or perhaps tons, when cut out of the stack, form the largest crop ever produced upon soils of the very richest quality.

Hay is sold in London, and generally throughout the southern markets, by the load, containing 36 trusses, each weighing 60lbs., until Michaelmas,

and 56 lbs. after that period, or 18 cwt. to the load. In many country places it is, however, estimated by the ton: at Edinburgh it is disposed of by the stone of 24 lbs. avoirdupois, delivered in bulk; for neither in Scotland, nor in Ireland, is it trussed for market.

The *operation of trussing* is in England performed with great nicety, and is so well deserving of imitation, that a description of it cannot be considered misplaced. The cutting is commenced at that end which is the least exposed to the weather, and should be begun at the left-hand corner. The binder begins by forming "thumb-bands" of the most inferior hay for tying up the trusses; in making which he is assisted by a boy, who holds both ends of a wisp of damped hay between his hands. He then catches the wisp with the crook of an implement called, in different places, a "twiner," a "throw-crook," or a "windle," which is made, like fig. 1.

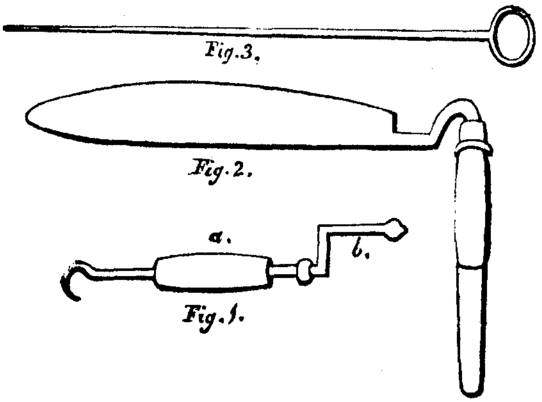
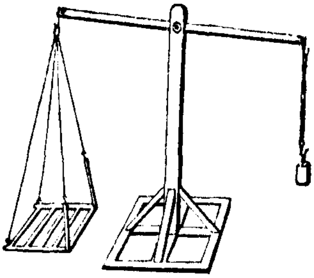


Fig. 3. Fig. 2. Fig. 1.

of a circular piece of iron about a foot and a half long, inclosed in a hollow tube of wood as at *a*. This he grasps with his left hand, and then turning the handle *b*, the crook revolves in the tube, and the band is instantaneously twisted. This done, he measures the cut to be made in the stack, which is decided by the usual size of the trusses—each being as nearly as possible three feet by two and a half, and thick in proportion to the fineness and closeness of the hay; those of the best quality being the thinnest. He then mounts the ladder and cuts perpendicularly through the thatch, as far down as will produce the requisite number of trusses. This he does with a very strong and sharp knife, about thirty inches in length by nearly six in breadth of the blade, and formed as in fig. 2. The handle is however often made short and straight from the blade, but the form above represented allows of more power being exerted by the workman in cutting through the stack, and it is an operation which demands considerable strength. Having cut the necessary quantity, he next uses an iron spike, nearly three feet in length, with a small handle at the top, as at fig. 3., which he thrusts into the truss, and thus separates it in nearly its exact weight from the stack; afterwards laying it upon two of the bands, which have been previously stretched upon a weighing machine, of the annexed form, and furnished with a 56 lb. weight, though steelyards are sometimes used, but are not more convenient, while they are more expensive. The machine can be made by any common carpenter of a size to hold a truss

of hay, the height about four feet, and of proportionate strength, for less than fifty shillings.



The truss is then encircled by the bands, at about 10 inches from each end, being afterwards turned under, as a tie, in the same manner as those of sheaves of corn. An expert hay-binder can thus truss two loads in his day's work; and the common price, if done by the job, is 2*s.* 6*d.* per load. It will be readily conceived that this mode is preferable to that of delivering hay loose; for although it occasions the charge of binding, it yet secures it from every kind of waste: it is accurately weighed, securely loaded upon the cart, occupies the smallest space, and can be easily carried or delivered, without difficulty, through a loft window.

The *measurement of hay in the stack*, for the purpose of ascertaining its weight, is made by multiplying the length, breadth, and height into each other; and if it has been allowed to settle in the stack during the winter, ten solid yards of meadow hay, in good condition, will generally weigh about one ton. The number of yards depending, however, partly upon the old or young state in which the grass was cut before it was made into hay, and partly upon the dry or moist condition in which it was stacked, as well as upon the length of time which it has lain—all these circumstances should be minutely examined; for if it is in a very large stack of more than a year old, nine, and in some cases eight yards will make a ton; clover, lying somewhat lighter in the stack, will generally take eleven or twelve yards to make a ton; and sometimes, when it has been stacked very dry, thirteen may be required; but the average of the last year's clover may be assumed at twelve yards *.

* Bayldon on Rents and Tillages, 3rd edit., p. 159. The mode of calculation is as follows:—Supposing the stack to be ten yards long at the bottom, and eleven at the eaves; four and a half wide at the bottom, and five and a half at the eaves; and presuming it to be four yards in height to the eaves, and to rise three yards to the point of the roof: in order to find the contents, the dimensions are summed up thus—

Medium length	10½ yards	
Do. breadth	× 5	
	52½	
Do. height	× 5	including one-third of the rise of the roof.
	10) 262½ = 26¼ tons, or 29½ loads.	

If the stack swells out considerably towards the eaves, the height—if taken against the sides—will appear to be greater than it is in reality; it should therefore be measured by a pole set up perpendicularly to the eaves. When it is required to measure an irregularly-formed stack, the contents may be found by giving and taking proportionate quantities of the separate parts, or by measuring or computing it in different divisions. If round, a more complex calculation is necessary, and can be hardly ascertained with

The *expenses of making hay* consisting chiefly of labour, vary, of course, in different places. Those in the district around London being the highest, we shall state according to the last estimate, as they may be reduced according to the rates in other parts, and are as follows:—

Mowing varies from four to six shillings per acre, according to the crop; but the general price is five. Making, including the wages of all the labourers employed in tedding, carting, and stacking—but exclusive of any charge for horse labour, which being performed by the farm teams is not included—is from ten to fifteen shillings, as the weather proves dry or wet, and the crop light or heavy; but it may commonly be got in from ten to twelve. Men and women will, upon an average, drink about four quarts of beer each per day, at 6*d*. per gallon—say, about 2*s*. an acre for beer; but, when the days are hot, the men at the stacks and with the carts have a more liberal supply to induce them to get on. These charges therefore amount to—

Mowing, say per acre	5*s*.
Making, do.	10
Beer, do.	2

On an average of soils and years the crop may be about one load and a quarter of meadow-hay per acre when cut from the stack; consequently, the expenses upon a load will be as follows: viz.

Four-fifths of the above sum	13*s*.	6*d*.
Thatching, about 2*s*. per load; but, as the straw will make bedding for cattle when it comes from the stack, say	1	6
Binding for market	2	6
Toll-bars and carter	2	6
Salesman for selling	5	0

And, if held over until the following day, 7*s*. 6*d*.

The actual outlay, in money, is therefore 25*s*. the load, to which must be added the expense of the team according to the distance to which it is to be carried, which may be safely estimated at about 10*s*. at the lowest; and as every farmer is bound by his lease—or even by the custom of the country if only holding his land upon a common agreement—to carry back a load of dung, or other equally efficient manure in return, that will cost about 4*s*. more; so that the whole charge cannot be calculated at less than somewhere about 2*l*. per load. This account differs but little from that furnished by Mr. Middleton in his Survey of Middlesex; but he estimates the entire expense of manuring once in three years, also those of tithes, taxes, and field-labour; thus making the whole charge amount to 5*l*. 5*s*. per acre, exclusive of rent *.

accuracy without having recourse to geometry. Mr. Bayldon, however, mentions a simple method, which consists in measuring the circumference at the bottom, and at regular distances up to the eaves, which must be added together, and divided by their joint number for a mean circumference; the square of which must then be multiplied by the decimal ·07958, and this product by the height up to the eaves, and one-third of the rise of the roof, added together, and this divided by 27 (the calculation being made in feet) will give the product in decimal yards.

* Middlesex Rep., 2nd edition, p. 259.

Chapter XXXIII.

ON THE CONVERSION OF ARABLE LAND TO PERMANENT PASTURE OR MEADOW.

All kinds of grass derive their chief value from the quality of the soil on which they are produced; for, whether natural or artificial, they afford more nutriment when taken from rich land than the same quantity of a similar sort will when procured from ground of a poor nature; and they are materially influenced by its state of wetness or of dryness. Every species springs originally from some peculiar earth, which is best adapted to its propagation; for although most of them will grow on various kinds of land, yet they all have their favourite ground, and if transferred from the soil on which they spontaneously vegetate to one of a different nature, prepared for them by tillage, they lose much of their hardiness and durability.

It might be supposed that, as almost every sort of grass can be made to thrive during a short period on different soils, a remedy for this could be found by sowing only the best class of seeds—and to a certain extent that effect may be obtained; but experience has proved that it is easier to accommodate the plant to the soil than to adapt the soil to the plant, and all land has such a tendency to reproduce those plants which are indigenous to the soil, that, after a series of years, more or less, according to the care which has been bestowed upon its cultivation, they will supersede those which have been artificially sown. This forms, indeed, one of the strongest reasons why sound old meadow should never be broken up without mature consideration; for to reproduce it is one of the most uncertain operations of husbandry. It is therefore evident that the closer we adhere to those seeds which are natural to the land, the more healthy will the plants be found, and the longer will the herbage retain those properties which are essential to its perfection; though it certainly may be much improved by a judicious selection of the better kinds, and by sowing only certain quantities of each, according as they are found to flourish with the most luxuriance, instead of sowing them indiscriminately.

Every one who intends to lay down land to a permanent state of meadow or pasture should therefore make himself well acquainted with the best natural grasses and the peculiar soils to which they are indigenous, as well as with the state of the land in regard to shelter, drought, or humidity, as affecting their growth and durability; and, having become master of these particulars, he should then select the seeds accordingly, either by purchase from some seedsman whose character may be presumed to guard the buyer from fraud, or, if desirous of obtaining them of his own growth, he may avail himself of the directions to be found at foot *.

* "If a piece of ground can be had that is neither very moist nor very dry, it will answer for several sorts of seeds, which may be then sown on one spot; but if such a piece cannot be obtained, they must be sown on separate spots, according to their respective qualities, no matter whether in a garden, a nursery, or a field, provided it be well secured and clean. Dig up the ground, level and rake it; then sow each kind of seed thinly in a separate row, each row about a foot apart, and cover them over lightly with earth: the latter end of August, or the beginning of September, will be the most proper time for this business. If the weather be not uncommonly dry, the seeds will vegetate quickly, and the only attention they will require will be to be carefully weeded. In about a fortnight from their coming up, such of the plants as grow thickly together may be thinned, and those which are taken up transplanted, so as to make more rows of the same grass.

So far, however, are farmers from generally paying any attention to this subject, that when they are in want of grass-seeds, they take them without any discrimination from the bottom of their own or their neighbour's mow, without considering of what species of grass they are, from what land they have been procured, or whether they are adapted to the land on which they are intended to be sown; "if they are hay-seeds, they are satisfied*." This, however, is very short-sighted economy; for after land has been got into good condition for the purpose of being converted into meadow, the further charge of the best seeds should never be spared.

It is also the common practice of farmers to sow those seeds with a corn crop, usually of barley; but, although they thereby save a year's rent and tillage, it is yet a losing plan in the end; for although the crop of corn thus obtained is valuable, yet when a good meadow is wanted, and when all the strength of the land is required to nurture the young grass thus robbed and injured, considerable expense is often incurred the second year for manure, which, with the charges of the crop, and the disadvantages attending it, will generally more than counterbalance its profit. A permanent sward of grass, with a bottom of richness and purity from weeds, can only be obtained by a thorough summer fallow,—so thoroughly effected as to cleanse the soil from every kind of weed and to reduce it to a complete state of pulverization before the seeds are sown. By this means, they may be deposited in the ground early in the autumn—about the middle or the latter end of August; and if the land has been got into good heart by sufficient manure, and the seeds be judiciously chosen, they will then not only stand the winter, but will probably sprout with such strength in the spring as to prevent the propagation of weeds. A top-dressing of some friable manure or compost, which must be exceedingly well spread and minutely divided, should, however, be laid on in the course of the month of March, as early as the land will bear pressure, and the ground should be carefully hand-weeded, lest any noxious plants should arise. The expense, indeed, is considerable; but, as may be seen in the more serious affairs of life, so in no farming operation will half-measures be found to succeed; and when a man has such an object in view as that of laying down land to

"If the winter should be very severe, though natives, they may, as seedlings, receive injury; therefore it will not be amiss to protect them with mats, fern, or by some other contrivance.

"Advantage should be taken of the first dry weather in spring to roll or tread them down in order to fasten their roots in the earth, which the frost generally loosens, and care must still be taken to keep them perfectly clear from weeds. As the spring advances, many of them will throw up their flowering stems, and some of them will continue to do so all the summer. As the seed in each spike or panicle ripens, it must be very carefully gathered, and sown in the autumn, at which time the roots of the original plants, which will now bear separating, should be divided and transplanted, so as to form more rows; the roots of the smooth-stalked meadow grass, in particular, creeping like couch grass, may readily be increased in this way; and thus, by degrees, a large plantation of these grasses may be formed, and much seed collected at its separate periods of becoming ripe."—Curtis on British Grasses, p. 31. Complete Grazier, 6th edition, p. 430.

Or, a piece of fine old meadow land, that is known to abound in the best sort of grasses, may be saved for seed by letting it stand a few weeks longer than usual, and thrashing the hay out immediately without suffering it to heat in the stack.—Middlesex Rep. 2nd edition, p. 305.—Com. to the Board of Agricul., vol. iii. p. 181.

An improvement on this latter mode would, however, be to divide the turf into three separate divisions, and to cut the grass from each at those different seasons when the plants respectively ripen their seeds, which usually is towards the latter end of June, the end of July, and in the first or second week of September; but great attention should be paid to the complete ripeness of the seeds, for if gathered before they are at perfect maturity they will not produce plants.

* Holland's Survey of Cheshire, p. 186.

produce crops without further cultivation during a series of years, he should calculate the loss which he will surely sustain if he does not effect it in the most complete manner. The land should in fact be put into such order as to produce nothing but what it is intended to grow, and to bring that to the utmost perfection; but to carry it to that condition, no expense should be spared. If, however, the soil can be brought into good order by the means of a turnip fallow, then indeed the sowing of the grass-seeds may be deferred until spring; although, even in that case, we should recommend their being sown without corn: in proof of which, we may cite the following trials on three different sorts of soils, as stated by the late Mr. George Sinclair*.

EXPERIMENTS.

1. A large field of *heavy clay*, in Buckinghamshire, which had been much exhausted by long continuance under the plough, was well cleaned, worked into as fine tilth as the unfavourable nature of the soil would permit, and manured with farm-yard dung and coal-ashes. The seeds were sown in August, at the collective rate of about four bushels to the acre, in different proportions in the order in which they stand; the largest being first, viz.—

Meadow fox-tail	Rough-stalked meadow
Meadow fescue	Crested dog's-tail
Meadow cat's-tail	White clover, and

Cow-grass.

The vegetation succeeded as satisfactorily as the season of winter would permit, but a top-dressing was given in the following spring, and a few more seeds were sown at the same time. The pasture soon became fit to receive dairy stock, and proved so productive, that, after four years' experience of its qualities, another field of a similar soil, on the same farm, was also laid down.

2. This, however, although worked in the same manner as the former, had the addition to the seeds of

Cock's-foot and perennial rye-grass,

which proved a great improvement; and the field was intended to be sown in spring. In consequence, however, of the difficulty of getting a flat tenacious clay into fine condition, the ground was not sown until the beginning of summer; but, although the seeds vegetated freely, yet such a quantity of charlock came up at the same time, that the plants were in danger of being choked, and it became necessary to give so thorough a hand-weeding, that it cost 12*s*. per acre. The grasses however sprouted vigorously, and in the course of two seasons became equal to any old pasture on a similar soil.

3. A ten-acre field of *strong loam incumbent on clay*, in a high and exposed situation in the county of Cumberland, got a fallow of ten furrows, and having been harrowed and picked till not a weed was to be seen, was sown in drills, with thirteen pecks per acre of the following seeds:—

Cock's-foot	Crested dog's-tail
Perennial rye-grass . . .	Sweet scented vernal
Hard fescue	Common meadow-grass
Meadow fox-tail	White clover
Tall oat-grass	Perennial red clover
Larger meadow cat's-tail . .	Trefoil, and

Broad clover.

* See the Quart. Journ. of Agric., N. S., Nos. xviii. and xix.; and also four other experiments of a nearly similar nature, published in the Transactions of the Highland Society, N. S., vol. ii. p. 198.

The next year it carried upwards of forty wether sheep, with thirty-three lambs, and twenty yearling bullocks; thus keeping as much stock during the autumn as a common turnip crop, and making the sheep equally fat.

4. *A light gravelly soil*, containing twenty-four acres, in Roxburghshire, was sown without a corn crop, on the 13th of April, 1832, with 2¼ bushels per acre of

Cock's-foot . . .	Sweet-scented vernal
Meadow fox-tail . .	Larger meadow cat's-tail
Pacey's rye-grass . .	Crested dog's-tail
Tall oat-grass . . .	Common meadow-grass
Mixed fescues . . .	Broad-leaved bent, or fiorin, and

White, perennial red, and yellow clover.

On the 28th of June, eight scores of Leicester ewes, with their lambs, were put upon this pasture, and remained there until the 4th August, when they were removed, but were replaced on the 13th by ten scores of ewes, without their lambs, which continued until the 4th of October, at which period the account ends.

On this Mr. Sinclair very justly remarks, "that such extraordinary results could hardly have been expected from what are called the artificial grasses, even if they were sown without a corn crop;" and he has stated that other experiments on various soils, and on extensive scales, have proved to him, "that, with clean preparation and judicious manuring, any land may be brought in a couple of years into a state of permanent meadow or pasture, nearly approaching to that of an ancient date, by sowing the seeds of the appropriate grasses." But, although entertaining the highest opinion of his judgment, yet in this instance we are inclined to doubt its accuracy, as all the information which we have been able to collect from other quarters shows that, after the first year or two, the luxuriance of the herbage declines, and is only after a long time so gradually renovated as to acquire the richness and elasticity which is peculiar to an old sward. There indeed can be no doubt that, by a skilful selection of the grasses most appropriate to the soil, a crop of herbage may be obtained of a quality so rich as to exceed that of the natural pasture during a short period; but that external coat composed of the tufts of grass or green turf, which we distinctively call *sward*, is formed by the roots, both alive and dead, and by the mould created by the decomposition of the latter, and therefore can only be produced in a long course of years.

MANAGEMENT.

The grasses, when sown, should be combined with perennial red and white clover, in various proportions, adapted to the distinct properties of the land; for although grasses differ from each other in their habits of growth—some putting forth foliage, ripening their seeds at different seasons, and yielding different qualities and weight of product—yet, should it be attempted to produce a rich sward by sowing the seeds of only one species of grass, it will be found, that however closely the seeds may be sown, and the seedling plants may cover the surface, yet a considerable number of them will certainly decay, leaving blank spaces to be filled up either by the accidental mixture of seeds blown from natural pastures in the vicinity, or by those of weeds. It is, indeed, a law of the natural economy of permanent grasses, to grow densely and promiscuously together; for they are found, side by side, in the richest natural pastures in such variety, that twenty different species, containing more than a thousand distinct roots, have been collected from one square foot of surface. It is, however, essentially necessary that the seeds be genuine and pure, as well as of the last

year's growth, and that they be so intimately intermixed that, if possible, two plants of the same kind should not grow up together. But if the proportion which will be hereafter mentioned be sown in sufficient quantities to stock every part of the land,—and with an appropriate selection of plants,—there can be little doubt that, if the soil be otherwise properly managed, the seedling grasses will be sustained, and may be brought to assume the character of rich pasture or meadow.

The management of the soil can, however, be only judiciously effected when the land is intended to be laid down, by rendering it in every respect as perfect as it can be made by previous tillage and manure, either through draining, paring and burning, or completely summer fallowing; and by the application of farm-yard dung, lime, chalk, marl, ashes, clay or sand, as circumstances may require; then, by carefully extirpating all root-weeds during the next and following season, by which time the surface will become closely covered with a thick and permanent sward. It should not only be perfectly clean and well pulverized, but the ridges should be levelled, and the furrows filled in, so as to render the surface quite uniform, and the seeds should be sown on a fresh tilth, finely harrowed. As regularity in delivery of the seeds is a point of the utmost importance, an expert seedsman should be employed, and they should never be sown either in windy weather or when the ground is so wet as to occasion the least degree of poaching. They are indeed sometimes sown by machines, in drills, in which they can certainly be evenly distributed, but the spaces between the lines must still be left void, and an experienced and careful workman can sow them perhaps more effectually broadcast. The light sorts should, however, be divided from those which are heavy, and they should be sown separately; for although this will occasion more casts than one, yet the trouble of going several times over the ground is not to be put in competition with the equal distribution of the seed *. They should then be lightly but well covered in with harrows—not heavy, but formed with closely-set and very short teeth or tines; and if the soil is either spongy, or porous, it should be afterwards lightly rolled; though a large fold of five or six yards to each sheep is a better mode of performing the latter. If the land be very light, or at all clotty, it is likewise advantageous to pass a light roller over it immediately previous to sowing the seeds. On strong land, however, rolling is not necessary; and as it is material, even on the very driest soil, to avoid the use of horses as much as possible on the ground after it is sown, it is very desirable to cover the seed with large hand-rakes, instead of harrows, so as wholly to prevent the foot-marks of the cattle.

The *best time of sowing* is, as we have already stated, *in the early part of autumn*—some persons even recommend the latter end of July †; but there can be no doubt that, if the land can be got perfectly clean, it may also be advantageously performed in the spring. If the first plan be adopted, and the succeeding winter should prove severe, it is, however, not improbable that some of the seedling plants will fail, and therefore a small additional quantity of seed should be sown some time in February, or not later than the first fortnight of March, and then well rolled down, as the

* The weights of the seeds differ so materially, that while those of most of the clover species exceed 60lbs. per imperial bushel; that of rib-grass, 50 lbs.; of meadow cat's-tail, 40 lbs.; and the different varieties of rye-grass vary from 16 to 30 lbs.; yet most of the poa and fescue tribes are under 15 lbs., and many of the other grasses below 10lbs.

† Bailey's Survey of Durham, p. 181.

roots of the early-sown grasses may have been loosened by the winter's frost. If the land has been previously limed, pared and burnt, or marled, this will also be found the best time for laying on the farm-yard manure, which is necessary to afford nourishment and strength to the roots; and even if that should have been already applied previous to the sowing, yet a top-dressing of rotten dung, or a well-prepared compost of vegetable and animal matter, will occasion the plants to flourish: for it will be seen that, like animals, the better they are supported in their youth, the stronger will they be when they grow up.

If, however, *spring sowing* should be chosen, then—if the land has not been previously prepared by a turnip fallow—the putrescent manure should be laid on before the seeds are put into the ground; if corn be sown at the same time, it should not be too thickly set, and the growing crop should be thoroughly hand-weeded. When the two crops are to be united, and the nature of the soil permits, barley is to be preferred to oats, for it has a greater tendency to loosen the texture of the ground, which is thus rendered favourable to the vegetation of the grass-seeds, and being reaped earlier, they will have the further advantage of being sooner exposed to the sun; for although a light crop of Lent corn is by many considered advantageous to their growth, by affording them shade and protection against the ardent heat of summer, yet, when they have acquired sufficient strength to be out of the reach of danger, it does them injury, as it protects every noxious weed equally as well as the young grass *.

The *management of the first crop* is a subject of much difference of opinion, some persons recommending it to be mown, while the greater number feed it off with sheep. The reason assigned for the former practice is, that by mowing it very early, and frequently rolling it, the grass acquires a closer bottom, and that sheep, in cropping the tender shoots of the seedling plants, pull some of them out of the ground. There may be some truth in this if the land be light, and sown, as such land frequently is, in the spring, though we have already seen, in experiment No. 4, that even under those circumstances but little danger of material injury need be apprehended; but on strong soils, with autumnal sowing, the roots will have obtained too firm a hold of the ground to be destroyed by being fed in the following summer, and the land will thereby have the advantage of the dung.

Regarding the *soils most appropriate to the production of the permanent grasses*, it may be observed, that no land can be expected to form a good meadow unless it be of a nature sufficiently retentive of moisture to afford nourishment to the roots, and to prevent them from being burnt up by the summer heats; though, if too wet, the herbage will become coarse, and infested with rushes and other aquatic plants. Loams are the best adapted, but they are too valuable to the arable farmer to be converted to grass; and therefore clays of so wet a nature as to be unsuitable to the plough, or else land which, without regard to quality, is either subject to be overflown, or capable of irrigation, are the soils most commonly laid down. It must, however, be borne in mind that, notwithstanding every care in the choice of the seeds, and the preparation of the soil for their recep-

* A practice prevails in some places, which consists in sowing half a peck of rape, or a bushel of spring tares, instead of corn, with the grass-seeds. The rape thus gets up sufficiently high to shade the young grass; and in the middle of July, ewes are turned in, with their lambs, to feed it off. This deserves attention; for the cole does not rob the land as corn does, while the feeding of it occasions a great increase of manure: the tares, however, are apt to smother the young grass.

tion, there are so many casualties which influence the growth of plants, that the difference of even half an inch in the quantity of rain which may fall in the course of the season will have a very decided effect in lessening the weight and value of their produce, although they may be of the like species, and in every respect, except as to soil and local climate, under exactly similar circumstances. Thus it has been justly observed by a late eminent botanist, that clear or hot sunshine may be highly beneficial on certain soils at a particular period of the progress of the crop, and on another and different soil it may be equally injurious; and moist or damp weather varies likewise in its beneficial effects,—or the reverse,—according *to the local circumstances of soil and site.*

The *perennial grasses which are found in natural pastures* amount to considerably more than a hundred different kinds; and there is no variety of soil but is provided by the bountiful hand of nature with grasses peculiarly adapted to grow and remain permanent in each. However similar many of these grasses may be when in a state of turf, no two species are found to agree in either the time of their being in the greatest perfection, the quantity or qualities of their nutritive matter, or any of the properties which constitute their value. Some are best for sheep, and flourish on elevated districts; others are calculated, on medium soils, for the dairy; and those on rich marsh lands for the fattening of cattle. Their periods of ripening are also different; and many, possessing different powers of withstanding the effects of drought or long-continued rains, consequently affect various kinds of soil.

The grasses which compose the produce of the richest natural meadow and pasture land amount, however, to only between twenty and thirty distinct species, the rest being comparatively of little value, and of these there is not a month, from spring until the close of autumn, but what, each in its particular season, occasions a superior luxuriance of growth, and brings them to ripeness. It will therefore be found, that by sowing the seeds of many grasses of dissimilar growth, there may be secured throughout the summer a succession of fresh herbage, so dense and abundant as far to surpass that to be obtained by the cultivation of only two or three species*. When combined, they vary according to the nature of the land; thus—

Sandy soils are generally stocked with hard and smooth fescue-grass; *sheep's fescue; crested dog's-tail; smooth-stalked and meadow soft-grass;* oat-like soft-grass, and some creeping plants of little note.

Calcareous soils abound with white clover; rough cock's-foot; meadow, hard and sheep's fescue; perennial rye-grass; upright perennial brome; rib-grass; yarrow; burnet; yellow oat, and sweet-scented vernal-grass.

Argillaceous soils encourage meadow fox-tail; meadow cat's-tail, or timothy

* On this subject, the observations which we have already made on hay-making may suggest the advantage of having in the same meadow those grasses which flower as nearly as possible at the same time; some farmers may therefore be convenienced by the following enumeration, calculated as nearly as possible upon an average of seasons and local climate:—

In *May and June*, meadow fox-tail, flote fox-tail, sweet-scented vernal-grass, narrow-leaved meadow-grass, clover.

In *June and July*, cock's-foot, crested dog's-tail, yarrow, bush-vetch, waved-hair and water-hair grass, tall oat and yellow oat-grass, perennial rye-grass, fine and creeping bent, all the species of the fescue, and the poas, or meadow grasses.

In *July and August*, flote fox-tail, fiorin, water-poa, or reed meadow-grass (which is the latest of the poas), and meadow barley.

The seeds of these grasses are generally ripe about a month later; and care should be taken not to gather them until in a perfect state of maturity, or the plants will fail.

grass; cock's-foot; tall and meadow fescue; tall and yellow oat-grass; rib-grass; yarrow; bush-vetch; sweet-scented vernal and perennial rye-grass.

Peaty soils have been found to contain sweet-scented vernal-grass; rough cock's-foot; meadow soft-grass; meadow fox-tail; meadow cat's-tail; creeping bent, and crested dog's-tail.

Fenny soils produce creeping bent, or fiorin; flote fescue; flote fox-tail; water-hair grass; and water-poa, or reed meadow-grass; and generally the usual aquatic plants.

A mixed soil, composed of these earths—sand, chalk, and clay—is found to give vigour to the following permanent grasses, of the qualities of the chief of which, and some of their varieties, we annex a brief description, together with some notes made by Mr. Taunton, a gentleman well known as an agriculturist, who, in 1823, sowed a great number on separate plots of a field of five acres of hazel-coloured loamy sand, upon a chalky sub-soil; as well as upon some calcareous heights in the county of Surrey; and which, since that period, have never been manured, nor in some years either mown or fed, until 1832, when his remarks were made*. Of these, several are known by the collective names of "*Poas*" and "*Festucas*," from these being the terms respectively applied to them by botanists: terms which we also retain in compliance with a custom lately introduced by almost every one who writes upon agriculture, though we cannot help thinking that, among farmers, it savours more of affectation than of any real knowledge of botany. Many of them, however, being only unimportant varieties of the same species, will not be here noticed, as those who may wish to ascertain the distinctive properties of each will find a minute and scientific description of every class of the natural as well as cultivated British grasses, in the "Hortus Gramineus Woburnensis" of the late Mr. Sinclair—a work which should be in the hands of every intelligent farmer.

Poa annua, or annual meadow-grass, is not, as its name implies, permanent; yet, being in flower at different periods during the whole of the summer, it produces seeds, even when mown or fed, which spring again, and thus it forms a part of the sward as constantly as if it were perennial. Cattle of every kind are fond of it, and it is thought to have a peculiarly good effect upon milch cows in improving the quality of the butter; though its produce is comparatively small.

Poa pratensis, or smooth-stalked poa, is one of the most useful grasses, for it vegetates in the driest soils, supports its verdure during the winter, and in the spring throws out numerous shoots for early pasture: the hay is also of fine quality, and it flowers in the month of May.

Poa trivialis, or rough-stalked poa, bears a considerable resemblance to the preceding, both in its appearance and in the value of its hay; but its other properties are in some respects widely different, for while that flourishes in dry land, this is chiefly found on low meadows or moist pastures, and is therefore well adapted to ground which is intended to be irrigated. It also flowers rather later than the former, and is a tender grass, liable to be injured both by severe cold, or by excessive drought. It however affords abundant herbage, and, in places suited to it, grows to such a prodigious length, that it is said to have been found in the famous Orcheston Meadow, near Salisbury Plain, full eight feet long†.

* See the Quarterly Journal of Agriculture, N.S., vol. iii. p. 406.

† Papers of the Bath Agricultural Society, vol. ix. p. 154. Both species propagate themselves, but very slowly, by the roots; and therefore, if not occasionally allowed to perfect their seeds, they will be subject to decay, unless fresh seeds be sown: in which case they should be separated by being well rubbed in a sufficient quantity of dry sand or lime, as they are connected by filaments which cause them to cling together. Those of the former are blunt; the latter pointed.

Poa compressa, or creeping poa, flowers during the greater part of the summer, and is considered one of the most valuable of the tribe; for its dark green leaves grow so firmly together as to form a short turf of the richest pasture, which is supposed to contribute much to the delicate flavour of the flesh of sheep and deer, to which animals it is peculiarly grateful.

Poa angustifolia, or narrow-leaved poa, is a rich grass which delights in calcareous sandy soils, as well as in loamy clay; but, being a running-rooted plant, it should be only sparingly introduced among other grasses.

Poa nemoralis, or wood-meadow grass, has the peculiar property of flowering under the shade of trees, which renders it valuable on land which either contains forest timber, or which is closely fenced by plantations; but Mr. Taunton says that in several beds of considerable extent on which he has sown it, the plants were completely overpowered by other grasses; this was also the case with several different varieties of the poa species, as well as with many other grasses, which he inclines to attribute to the seeds being sown in too large quantities.

Festuca pratensis, or meadow fescue, is a hardy plant, which bears broad succulent leaves, and, though a coarse grass with very hard stems, is well adapted to almost every kind of land, but more particularly to loams, active peat soils, or healthy well-drained clays: grows naturally on all pasture land that is not too dry. It is of very quick growth, produces an abundance of sweet herbage which is much relished by all sorts of cattle, makes good hay, and flowers about the middle of June. Its seeds are also very abundant, and easily collected.

Festuca elatior, or tall fescue, Mr. Taunton considers as both the largest and most vigorous plant of which he is possessed. In a small meadow, on a loamy clay, which has not been manured for these nine years, but in which it forms a principal, he still cuts two tons of hay to the acre; and he finds that both these species also abound and increase on the better specimens of calcareous loamy sand.

Festuca ovina, or sheep's fescue, forms a thick and fine turf on dry sandy soils, and on elevated land forms a pasture which has been much recommended for sheep; but according to the experience of an eminent agriculturist, this species of fescue, and its other numerous varieties, have been described, from repeated observation, as being constantly refused both by sheep and all other cattle, whenever they could get any other kind of food *. It is, however, found very commonly upon the downs, together with the *festuca duriuscula*, or hard fescue, the *festuca glabra*, or smooth fescue, the *festuca Cambrica*, or Welch fescue, and the *festuca rubra*, or creeping fescue, which are therefore all well adapted to poor land; and their herbage being nearly evergreen has been described by Mr. Sinclair as invaluable for winter pasture.

Festuca loliacea, or darnel-like fescue, in some respects resembles rye-grass, and has been supposed by botanists to be a hybrid plant, produced by rye-grass and flote-fescue; but this is a mistake, as the darnel both springs earlier and is superior in produce to rye-grass†.

Lathyrus pratensis, or meadow vetchling, furnishes a copious, succulent and tender herbage of very considerable bulk, is relished by cattle, and forms an important addition to the crop of hay, though it flowers late. The *vicia sepium*, or bush-vetch, which is a variety of the former—both being species of perennial tares—flowers earlier, though not until July, and some extraordinary instances of its product have been recorded in different experiments regarding its culture‡. Mr. Taunton found that they had spread both on his sandy loam and upon his clays; but although the latter had the advantage in point of increase of plants on the light land, yet the produce was not so large as upon a more clayey soil.

Plantago lanceolata, or rib-grass, though generally combined with other grasses, yet has been sown without admixture, and produces a considerable

* Essay by George Tollet, Esq., Comm. to the Board of Agric. vol. iii. p. 428.

† Sinclair, Hort. Gram. Woburn., p. 179.

‡ Withering on British Plants, vol. iii.; and letters in the Papers of the Bath Society, vol. iii.

herbage on rich sands and loams, and on poorer and drier soils answers well for sheep; being much used on the hills in Wales, where its roots spread and occasion a degree of fertility in districts which would otherwise be little better than bare rock. But botanists differ in their estimation of its qualities, for by some it is said to be injurious to cows, and by others it is asserted that the richness of the milk in the celebrated dairies of the Alps is attributable to this grass, and the common lady's mantle, or *alchemilla vulgaris*. When sown along with clover it is also said to prevent cattle from being hoven *.

Poterium sanguisorba, or burnet, is also frequently sown alone, and is considered as the best adapted of all forage plants to bear the rigour of winter in exposed situations; it is, therefore, much used by stock masters, particularly for sheep, as it supplies an important addition of food in the pinching season of the early part of spring; but if made into hay, when uncombined with other grasses, it is coarse and unpalatable. By itself it is, indeed, an inferior food; for although it possesses a tonic and aromatic property, which renders it of considerable value when mixed with the grasses of the elevated pasture of the downs, and it is there invariably cropped close to the ground, yet if grown separately it is rejected by all stock, unless they be pressed by hunger. When intended for summer pasture, or for hay, it should therefore be joined with other grasses; or, at least, with white clover, which will both render it more palatable, and afford a heavier crop than if sown alone. On poor chalky soils it has also been tried with good effect in combination with cock's-foot, and also with small quantities of meadow fescue and perennial fescue; and its hardy nature on soils of that description renders it worthy of attention. It forms, indeed, a large portion of the natural herbage on some extensive tracts of the South Downs, and although most abounding on chalk, it thrives also in both sand and gravel.

Alopecurus pratensis, or meadow fox-tail, which is one of the earliest and most valuable grasses produced in our climate, vegetates with extraordinary luxuriance, and is therefore abundant both as a first crop and as after grass; it is therefore justly considered as holding the first place among the best grasses, whether used green as fodder, or made into hay, and cattle are very fond of it, though it is said to be less relished by oxen than by other stock. It produces a great quantity of seed, which may be easily gathered while the grass is growing, as it overtops most others; but the seeds are seldom found in hay, for they generally ripen and fall out before the other grasses are ready to be mown. There are two other species of the fox-tail, which all flourish chiefly on strong moist soils, but, although each bearing nearly the same character, this is the best. Mr. Taunton says, that on his dry ground he found them all considerably weakened, and that one of them—a German black-seeded species—had nearly disappeared; but where they were mixed in a meadow on clay, with a dark moory mould on the surface, they each maintained their size and bulk as well, or better, than any other grass. They indeed grow to great perfection on all moist loams and clays; and although not cut until late in the summer, when the radical leaves of many other grasses are decayed or withered, these continue green and present no impediment to the scythe. "In fine, it possesses all the requisites of a good grass—namely, quantity, quality, and earliness." It yields also abundance of seeds, but they are subject to be destroyed by an insect.

Cynosurus cristatus, or crested dog's-tail, grows upon sandy and calcareous soils, and is therefore well calculated for dry upland pastures, where it forms a thick, short turf, and affords wholesome food for sheep. It flowers about July; but the variety called *Cynosurus cœruleus*, or blue dog's-tail, which is found upon the tops of the highest limestone rocks, is one of the earliest grasses, and as it endures the summer drought, is therefore well calculated for sheep pasture.

Phleum pratense, or meadow cat's-tail, of which there are two varieties,—the larger and the less,—is also known as "Timothy-grass," under which name it has been extensively cultivated, uncombined with other grasses, in America, where it produces very large crops, and when first imported into this country

* Cheshire Report, p. 181.

was supposed to be a new species. It is chiefly produced on moist and rich loams and peaty soils; was found by Mr. Taunton to have nearly vanished from his chalk and rich loamy sand, and to have entirely disappeared from the poor calcareous heights. The first variety is said by Mr. Sinclair to be the most valuable for pastures of the first and second quality of land; yet the second is superior, particularly for winter food, in the poorer soils. On the elevated declivities of clay soils it pushes up shoots of great succulence, which, if neglected in the summer, are rendered palatable to stock by the frost*. When used for green food, for which purpose it is peculiarly calculated, it yields abundantly throughout the summer, and is well relished by cattle if kept close fed down; but if made into hay, it should be cut before it comes into flower, as the stems will otherwise become as coarse as straw: it, however, flowers late, and may, therefore, be advantageously mixed with other meadow grasses, though its seeds are small and difficult to collect.

Dactylis glomerata, or rough cock's-foot, flowers in June, and is also sometimes cultivated alone, but in that case it should be likewise cut early if made into hay, or kept close fed down; for, if allowed to become rank, it grows very coarse, and will in that state be rejected by cattle, though in its young growth they readily eat it, and sheep have a decided liking for it. If allowed to get up it also forms large tufts of a very unsightly appearance, which overpower the other grasses. It produces very abundant crops upon land of a medium quality, on most of which it is very common, but light sands, or chalky downs, and either a total want of clay, or very stiff and wet clays, are alike unfriendly to its growth. It springs early, which is an essential point in pastures; and, if made into hay, it quickly yields an abundance of after-grass. If sown alone, two bushels per acre is the usual quantity; and, as it thrives with great luxuriance under the shade of trees, it is a valuable plant to be sown in orchards.

Avena elatior, or tall oat-grass, though a coarse plant, yet vegetates with great luxuriance; but, according to Sir Humphry Davy, though very productive, it is disliked by cattle, especially by horses, which, he says, perfectly agrees with the small portion of nutritive matter which it contains. He adds that it thrives best on strong tenacious clay; but Mr. Sinclair states that its variety, the *Holcus avenaceus*, or tall oat-like soft-grass, though found in clays and shady places, is natural to sandy loams†.

Avena flavescens, or yellow oat-grass, though another variety of the above, is stated by Sir Humphry Davy to thrive so much better on calcareous soils, that its produce has been doubled by a top dressing of lime; but that, although not liked by cattle, it is said to make good sheep pastures. As they both, however, seldom flower before the beginning of July, they are generally mown before that time; and, therefore, being then comparatively tender, this dislike, if it really exists, is not observable in the hay. Mr. Tollet says that cattle are very fond of it; and the Rev. Arthur Young states it to be a profitable grass "when kept close fed‡." This difference of opinion we must leave to the experience of others to reconcile, only remarking, that we have never heard any objection made to it by farmers; as well as that of Mr. Taunton regarding the soil to which it is most appropriate, for he says, "that in parts where the soil was too light to encourage its luxuriant growth it dwindled and became insignificant, but that it appears to cherish a considerable affection for argil." He adds, however, "that it is so rich in its qualities, and so universal a citizen of the world, that there is no soil, from the lightest calcareous loam to the stiffest clay, into which he would not introduce it where he intended to produce a permanent turf."

Achillea millefolium, or yarrow, is one of the most common as well as one of the most valuable of our grasses, as it has been found to form part of

* Sinclair on the Grasses best adapted for Winter Pasture: Prize Essays of the Highland Society, No. xx p. 32

† Davy's Lectures on Agric. Chem., p. 368. Sinclair on the Grasses best suited for Winter Pastures: Prize Essays of the Highland Society, No. xx. p. 32.

‡ Davy's Lectures, p. 369. Tollet, Comm. to the Board of Agric. vol. iii. p. 433. Young, ib. 146.

all our richest pastures, and is so grateful to every species of stock, that it is close fed down as fast as it springs, thus frequently escaping observation unless the turf be attentively examined. A considerable prejudice was, however, formerly entertained against this plant, which was by many persons considered worthless, or even injurious to cattle, until the contrary was proved by Dr. Anderson*, and confirmed by Sinclair, who, however, considers it beneficial to stock rather as a condiment than as affording direct nutritive matter. It suits almost every species of soil, and possesses besides the faculty of resisting drought on arid land. It flowers about the end of June or the beginning of July.

Holcus lanatus, or woolly soft-grass, called also "Yorkshire white," flourishes about the latter end of June in moist, sandy situations, and together with another variety, the *Holcus mollis*, or common soft-grass, is chiefly used on sheep walks, and answers well for that purpose, but is not relished by other cattle, and is said to occasion a violent discharge of urine and general weakness if given to horses.

Anthoxanthum odoratum, or sweet-scented vernal, is one of the earliest of our grasses, and grows on almost every kind of soil. Although neither very productive nor nutritive, and far from being a favourite with cattle when given to them alone, it yet possesses the peculiar value of being the only fragrant plant natural to our fields, and imparts the delightful perfume which is so perceptible in new hay. It, indeed, forms a part of the herbage on all good meadow land, and although its chief utility seems to consist in giving flavour to the dried fodder, yet, when thus mixed, it is grateful to all stock, and, therefore, should always be sown with the other seeds of permanent grass

Lolium perenne, or perennial rye-grass, contains upwards of sixty varieties, some of which are annual. It has been so anciently cultivated in England that it is mentioned in "Worlidge's Husbandry," in 1677, since which time there have been numerous improvements on the common sort, of which those best known are Pacey's, Russell's, Whitworth's, and Ruck's, which are all considered perennial. Mr. Taunton, however, observes, "that not only in his experimental ground, but in his field culture, on chalks, and on the deepest and richest loamy sand, he has experienced the utter eradication of every variety of the most approved species; though he does not feel himself warranted to infer that there is no species of rye-grass which is perennial on certain soils, as his experience induces him, on the contrary, to believe that in different parts of the kingdom it is indigenous." It is, notwithstanding, found to flourish on most kinds of soil, and grows under circumstances of different management on many upland situations, though sound and somewhat moist midlands are the most appropriate. It soon arrives at perfection, and produces in its first years of growth a good supply of early herbage which is much liked by cattle, and has been described by Marshall as of such forcing quality that, "no matter how short the first spring grass may be, so the cattle can get hold of it, they are sure to thrive amain †." This, however, may be easily accounted for, as there is not at that season of the year another blade of grass to lower its value.

These apparent merits have doubtless upheld its use among farmers as a favoured grass, and it is not uncommonly sown in arable land, along with clover, for a single crop; but the lattermath is very inconsiderable, and it impoverishes the soil in a very great degree if the culms—which are invariably left untouched by cattle when they grow strong and coarse—are not cut before the seed arrives at perfection. Notwithstanding this, it is, however, sometimes left to stand for seed, in which case it is thrashed like other grain, but the straw only serves as litter. To this we have also to add, upon the authority of Mr. Sinclair, that if the nutritive powers of rye-grass be compared with cock's-foot, it will be found inferior in the proportion of nearly five to eighteen; also inferior to meadow fox-tail in the proportion of five to twelve, and to that of meadow fescue as five to seventeen ‡. The chemical analysis on which

* Essays, vol. ii. p. 252.

† Rur. Econ. of Gloucestersh., vol. i. p. 162.

‡ Hort. Gram. Woburn., p. 215.

he founds that assertion must, however, be received with some degree of caution; for it unquestionably does not accord with the experience of farmers.

There is, however, another species of this plant which has been lately introduced from the continent under the name of *Italian rye-grass*, and is distinguished from the common species by its larger leaves, by being of a darker green, and by growing to a greater height. On comparative trials with some of the most favourite kinds of the common rye-grass, it has been found to exhibit a great superiority of growth, and it has been represented as being softer, more juicy, and more greedily eaten by cattle, whether in a green or dry state. It is also said to be of such a hardy nature that, when cut in November, it has put forth fresh shoots of a foot in length in the close of December, and has been found to stand the winter in the north of Europe. Its durability in the soil, as a perennial grass, remains yet, however, to be proved; and, although the experiments which have been already made seem to confirm the high character which has been given of it in other respects, yet further experience seems necessary to determine its real value*.

Trifolium repens, or white clover, is also known under the name of "Dutch clover," from our having first learnt its use from the Flemings, and from large quantities of the seed being imported from Holland. Its favourite soil is limestone, but it is one of the most general grasses throughout this country, being found in almost every situation from the lowest to the highest meadow, though on very poor land it is often so small and grows in such a creeping manner among the lower leaves of other herbage, that it is scarcely perceptible until brought up by top dressings; which probably has given rise to the very general opinion that it is indigenous to some soils. The central root penetrates to a considerable depth, and the plant is thereby enabled to resist the effects of drought, particularly on sandy soils: the branches which trail on the surface send fibrous roots from their joints down to the ground, and hence this species of clover maintains itself in land of opposite qualities; for if the surface be too dry to afford nourishment to the foliage, it is preserved by the roots. It is not, however, so nutritive as the common annual red clover, nor does it form a good pasture when sown by itself, for it has been found to occasion disease in sheep; but, combined with other grasses, it is a valuable plant†.

Trifolium pratense, or native red clover, known also by the name of "marle-grass," is a perennial plant, while that species, which also bears blossoms of the same colour, and is so generally cultivated in arable land, is only biennial. There is likewise a variety termed "cow-grass," which is still more permanent than the former, and is therefore more generally sown among grasses. This bears a rich purple flower, which comes into bloom in the month of July, and was found by Mr. Taunton to furnish a darker coloured and heavier swath than any other part of his experiment ground; it is, therefore, decidedly perennial; and, considering that no manure had been applied to this spot during the previous eight years, it proves that it will clothe even a light sandy soil with luxuriant herbage.

Ranunculus acris, or butter-cup, and *Rumex acetosa*, or sorrel, are only noticed to be avoided, for although they are both found in our pastures—the former particularly in some of the richest—yet they are never seen to be eaten by cattle of any description, unless pressed by necessity. The presence of sorrel also indicates a state of acidity in the soil which can only be corrected by the application of lime.

From this number any intelligent farmer may select those seeds which are the most appropriate to his land; for it is very difficult to furnish any

* In the *Bulletin des Sciences Agricoles* it is stated to be generally sown in the autumn at the rate of 16 to 18 lbs. per acre, and the seed rolled in; that in the next autumn the turf is covered like an old meadow, and the crop of the following year is more than double: its growth, also, is so rapid, that if sown with clover or lucerne, it will quickly choke them.

† Sinclair, Hort. Gram. Woburn., p. 223.

general rule on the subject. On laying down land of a medium quality, without reference to any particular soil, the following will probably, in many cases, be found the most useful. The quantity to be used must, however, be varied according to circumstances, as the proportions of the different species to be sown must always depend on the nature of the soil; and if every kind should not be sown, the others should be increased accordingly.

Smooth-stalked poa . .	8 quarts.	Yellow oat-grass . . .	4 quarts.
Rough-stalked poa . .	8 „	Perennial rye-grass . .	12 „
Meadow fescue . . .	12 „	Cock's foot	4 „
Meadow fox-tail . . .	8 „	Yarrow	4 „
Crested dog's-tail . . .	6 „	Sweet-scented vernal . .	2 „
Rib-grass	4 „	White clover	6 lbs.
Timothy-grass . . .	4 „	Cow-grass	4 „

and annual meadow-grass.

The common practice is, with the exception of clovers, to sow those seeds by measure; but it has been suggested by Mr. Lawson, of Edinburgh, seedsman to the Highland Society, that it would be more correct to sow them all by weight; "for although in grass-seeds the greater weight of one is no criterion of its superiority over another variety of less weight, yet a greater weight in the same variety always denotes a superior quality. Thus when seed is light, and consequently inferior, the greatest number of seeds is obtained by adhering to a given weight; and hence there is the chance of nearly an equal number of plants springing up as when the seeds are plump and heavy." With this view he has given several tables regarding the application of the different seeds under various circumstances; one of which we here select, and refer our readers for the remainder to his essay in the Quarterly Journal of Agriculture *.

FOR PERMANENT PASTURE, PER IMPERIAL ACRE.

	Light soil.		Medium soil.		Heavy soil.	
	With a crop.	Without a crop.	With a crop.	Without a crop.	With a crop.	Without a crop.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs
Perennial rye-grass ..	12	24	12	24	12	24
Meadow fox-tail......	1¼	2½	2	4	3¼	6½
Timothy-grass.......	—	—	1½	3	3½	5½
Meadow fescue.......	2½	4	2½	4	2½	4
Cock's-foot..........	5	8	3¼	6½	2½	4
Rough-stalked poa....	—	—	1¾	3¼	3¼	6¼
Smooth-stalked poa...	3¼	6½	1½	3¼	—	—
White clover........	5	8	5	8	5	8
Red clover...........	1½	2½	1½	2¼	1½	2½
Hop-clover, or trefoil..	1½	2½	1½	2½	1½	2¼
Cow-grass...........	1½	2½	1½	2¼	1½	2½
	33½	60½	36	63½	36½	66

We have reduced the above, as nearly as we could without descending to fractions, from the weights given for the Scotch acre; and although we are of opinion that a more complete selection might have been made, yet it will serve to call attention to the principle on which the table has been framed.

There is a very large tract of land, called *Stone-brash*, which extends

* New Series, No. xxiii.

from the north of England through Warwickshire, Gloucestershire,—the Cotswold hills being almost wholly composed of it,—with some parts of Wiltshire and Somersetshire. Under the greater portion of this district there are beds of marl, which have been very much used in the conversion of arable to grass, and with such extraordinary advantage, that the value of the ground is said to have been in some instances trebled, and even quadrupled, in value. The grasses usually sown are—

Perennial rye-grass . .	1 bushel.	White clover	3lbs.
Marl, or cow-grass. . .	10 lbs.	Hop-clover, or trefoil . . .	1lb.

The grasses are sometimes mown and sometimes fed in the first year, though the latter is considered the better practice, and the marling does not take place until the following July, as it is necessary that the land should be well covered with grass when the marl is laid on; for if the surface be naked it will cake, and the summer's heat will burn up the young plants. No natural grasses are sown, but they come up spontaneously, and in about three years they take place of those which are artificial. From that time—as we learn upon the authority of Mr. Davis of Longleat, the surveyor of Wiltshire—the land continues, for the space of nearly twenty years, and sometimes more, to be equal to the best native meadow-land in the country; but after that period the marl sinks into the ground below the reach of vegetation, the grasses decay, and mosses take their place. When again ploughed up, it, however, bears several crops of corn previous to a repetition of the marling, which is done in the same way as at first, and with equal success *.

Nearly the same plan of seeding has been followed in Dorsetshire and some other places which do not possess the advantage of marl, only varying the quantity of all the seeds except rye-grass, to equal amounts of six or seven pounds each. By this means there is an almost constant supply of feed: for the hop-clover and rye-grass supply it early in the spring; the cow-grass is in perfection in July, when the former decline; and the white clover from August to the remainder of the season. The grasses, however, only last during five or six years †.

AQUATIC GRASSES.

When, however, the soil is chiefly composed of one principal ingredient, as, for instance, if chalk, peat, or very wet clay greatly predominates, but few of the grasses will grow in combination. Thus several of the aquatic species which are found in wet low lands and boggy soils, will, however thickly sown, ultimately become solitary: of this nature are—

Alopecurus geniculatus, or flote fox-tail, which grows in situations so liable to inundation, that the other good grasses, if sown there, are soon expelled. In respect to the degree of moisture which it will support, it stands between the rough-stalked poa and the flote fescue, and thus forms a connecting link between our fens and moister meadow lands; for it is found in some of the richest marshes, and is then much esteemed for its fattening qualities in pasture as well as for hay. It is a creeping plant, which flowers in May and June, and grows from the centre in a nearly horizontal position, the lower joints touching the ground, and it may be propagated by slips ‡.

Festuca fluitans, or flote fescue, which grows sometimes in water and sometimes out of it, yet cattle are so fond of it that they often endanger themselves to get at it, and it is said that the Cheddar and Cottenham cheese owe to it

* Comm. to the Board of Agriculture, vol. iii. p. 90.
† Ibid. p. 10.
‡ Survey of the County of Antrim, part i. p. 250.

much of their celebrity. It springs early, and, when made into hay, it is soft and pleasant if cut in the sap, and bears a bluish green colour. There is also a variety called *festuca loliacea*, which flowers in June and July, and is found in marshy situations, where it is considered a valuable grass, but it has a coarse, broad, reed-like foliage.

Aira aquatica, or water hair-grass, which is found in a wild state on the margins of pools of standing water, where it flowers in June and July, and is grown in some of those fens which have not been perfectly drained, is also said to contribute much to the fine quality of the Cambridge butter.

Poa aquatica, or water poa, also called reed meadow-grass, flowers in July and August, and is very highly esteemed throughout the fen-lands of Cambridgeshire and Lincolnshire. It is, indeed, so particularly abundant as well as so much valued in the Isle of Ely, that it there forms a great source of their dairy riches, being considered excellent food for cows, though not relished by horses, and grows to the great height of six feet; it is, however, usually cut when about four feet high, and is bound up into sheaves. When stacked, and lightly fermented, it acquires a white surface, and is provincially termed "fodder," to distinguish it from other kinds of coarse grass which are called "stover." Immense tracts which were formerly overflowed are now covered with this plant, which, from its strong stem and upright growth, is suited to places unfit for the finer grasses: there is also a variety, known as *poa fluitans*, or flote poa.

Some of these have in many instances been sown among the grasses recommended for laying down meadows, and in most wet soils they deserve attention; for, on land where they thrive, they produce a great abundance of valuable fodder. There is, however, no species of aquatic grass which has of late years attracted so much attention as that called

Agrostis stolonifera, or creeping bent-grass, now more generally known as "Fiorin"—signifying, as we understand, in the Irish language, "grassy," and which much resembles the water hair-grass; but of which there is also a variety called the "broad-leaved bent." This, though formerly well known as a weed, was only introduced to public notice as a cultivated grass within the last twenty years, when it was so highly extolled by the Rev. Dr. Richardson, of Clonfecle, in the county of Antrim, that it soon attracted general attention, and, after a minute investigation of its merits by several eminent agriculturists, the Doctor was honoured with a medal by the Board of Agriculture. In an account published by the Agricultural Society of the Stewartry of Kircudbright, some of whose members visited Dr. R.'s farm for the purpose of examining its qualities, it is described as putting forth a great profusion of lateral strings, like the side shoots by which strawberry increases, and by which it is propagated; but the roots penetrate but a short distance into the soil, thus denoting that its chief sustenance is drawn from the atmosphere, and it is represented—

> 1st. To grow luxuriantly in low and swampy grounds; which, but for the cultivation of it, would be of little or no value.
>
> 2ndly. That it grows in such great quantities in irrigated meadows which are most favourable to it, that it has been known to produce above four times the weight of any single crop in general reared of any other grass.
>
> 3rdly. That all cattle are so extremely partial to it, as to prefer the hay made from it to any other hay whatever; and that, from the length of time which it annually vegetates, it may be used as green food during the greater part of winter *.

* *Farmer's Magazine*, vol. xiii. p. 4. Dr. R. has stated, upon the oath of the person who measured the ground and weighed the hay, "that one portion, not manured the preceding year, produced at the rate of 6 tons the English acre; that another portion, which had been manured, yielded at the rate of 7 tons, 4 cwt., and that when weighed, the hay was dry, rattling, and merchantable between man and man by weight."—Ibid. vol. x. p. 508.

It indeed preserves its vegetable life so long that it continues in vigour from the beginning of October until the end of March, and has not only been actually made into hay in the month of December, but when allowed to lie uncovered in small cocks, it did not rot as common hay would have done. As this, however, is a tedious and troublesome process, it is better to give it to cattle green, upon the soiling system, as it does not admit of being pastured; and it has been found to occasion a great flow of milk in cows, as well as to give it a good flavour and superior richness *. There is, however this inconvenience in giving it in that state—that, being a jointed plant, and very tenacious of the power of vegetation, any part of it which happens to be left by the cattle and is thrown out upon the dung hill, if afterwards laid upon arable land before it is completely decomposed, will there take root, and spread in a manner which renders it very difficult to be got rid of: it has even been thus found to spring up when taken from the hay-rick.

Although it may be propagated by the seeds, yet they are of such slow growth that they are apt to be overpowered by weeds, and the better mode is to plant small cuttings of the grass in the latter end of autumn: fine crops have indeed been obtained which were planted in the middle of December. The land should be drained as well as circumstances may permit; for although it suits a wet soil, and irrigated land, yet the water should not be suffered to rest upon it: the ground should then be well cleaned and pulverized, and the cuttings scattered over the surface, after which it should be very slightly covered with loose earth, or with peat ashes and earth well mixed. These cuttings are prepared in the simplest manner by twisting the strings into loose ropes about the thickness of the arm, and then cutting them with a hedge-bill upon a plank into lengths of about three inches and a half. When the crop comes up, it should be carefully weeded two or three times during the first year; after which there will be no occasion for a repetition of that process †.

We have thus inserted Fiorin among the list of aquatic plants, for it certainly thrives best on very wet soils, bogs, and cold clays, or upon land that has been irrigated; and although it can be grown on sand and other poor soils, yet the crops are there very insignificant, and it requires not only a wet soil, but also a moist climate, to bring it to perfection. Its most valuable quality appears to be the green food which it produces throughout the winter; for, on land that is too heavy to admit of turnips, there can be no doubt that it may be rendered a valuable addition to the straw yard. On those peaty soils which abound throughout Scotland and Ireland, and the climate of the latter of which, as well as that of the west of Scotland, favours its production, it may also be considered very advantageous, especially if planted alone, unmixed with other grasses; but in other situations it is exposed to the objection of neither supplying spring-food, nor producing a second crop within the same year. Although succulent and palatable, and shown upon the authority of experiments on the fattening of cattle stated by Mr. Aiton, to be capable of fatting a stot of upwards of thirty stone, in one hundred to one hundred and fifty days, according to the condition of the animal when put up, with less than fifty pounds of fiorin hay alone, without any other food ‡; yet this has been contradicted by other details §, and its cultivation has not been so generally

* It has been stated, on the authority of Sir James Stewart, of Coltness, Bart., that the average produce of butter fed sometimes with 8lbs. of steamed potatoes, with an unlimited quantity of oat-straw, and at other times with 16lbs. of fiorin hay, and straw in like manner, was as 55¼ to 39⅝ ounces from 6 gallons of milk; or 40 per cent. in favour of fiorin.—Farm. Mag. vol. xxi. p. 59.

† See Tracts on Fiorin Grass by the Rev. Dr. Richardson, and Davy's Agric. Chem. p. 366.

‡ Farmer's Magazine, vol. xvi. p. 53

§ See the Reports of the Counties of Antrim, part i., p. 250; Derby, vol. ii. p. 202; Stafford, p. 72; and Dumfries, p. 256.

diffused, even in those situations to which it is peculiarly appropriate, as the accounts originally given of it seemed to promise.

The choice of these aquatic plants must be regulated by the different degrees of moisture in the soil. On fens and morasses, if fiorin should not be chosen, perhaps there is none better, after a first drainage, than the water poa, which, by its spontaneous growth, will afford large crops, and at the same time allow the land time to settle. Such soils, however, consisting chiefly of decayed vegetable matter, require the aid of lime, or some alkaline substance, to bring it into action; after which they may be brought in the regular course of cultivation to produce good permanent pasture. In situations not quite so wet the flote fescue, flote fox-tails, and rough-stalked poa may be added; and on land still better drained the following mixture has been recommended:—

Flote fox-tail	4 quarts.	Meadow fox-tail	2 pecks
Flote fescue	2 do.	Meadow fescue	2 do.
Rough-stalked poa	2 pecks.	Vernal grass	2 quarts.

The latter, if the land be merely intended for pasture, may be omitted; but if meant for hay, should always be added*.

WINTER GRASSES.

On sheep-walks, or grass-farms, which are deficient in winter pasturage, Mr. Sinclair recommends the introduction of the following hardy and productive grasses, by the means which we have already stated of scarifying and top-dressing; namely—

Tall meadow-grass, and meadow fescue	3	pecks.
The former only on very heavy land constantly fed by cattle; and on sandy soils, one or more of the hard-fescue, smooth-fescue, or creeping-fescue, should be substituted for both the above.		
Cock's-foot	4	„
Timothy, if the soil be very cold and clayey; and on peaty soils, both species to be sown equally divided	¾	„
Tall oat-grass	2	„
Broad-leaved bent, or fiorin	1	„
Woolly soft-grass, only in cases of considerable elevation and poverty of soil, when it may be substituted for fiorin; and the oat-grass may also be left out, making good the deficiency, however, by a proportionate increase in the other species.		
Pacey's perennial rye-grass	3	„
Burnet	2	„
Perennial red clover, or cow-grass	6	lbs.
White clover	8	„

The quantities of the above have, however, been calculated according to the full complement requisite to form a new and complete pasture,—only omitting the dwarf grasses, which are not necessary to be enumerated,—but the proportion of seeds which may be required to fill up the old sward with plants, must, of course, depend upon its deficiency in the different grasses: the full quantity of seed required for an acre being about four bushels. The meadow fescue, and tall oat-like soft grass, and meadow cat's-tail, being, however, with the exception of fiorin, all plants of a later habit of growth than the others, and the greater part of them sending up a second, or a third growth of perfect herbage, sufficiently point out their superior value for winter keep †.

* Comm. to the Board of Agric., vol. iii. p. 445. Antrim Rep., part i. p. 249.

† Sinclair on the grasses best suited for pasture during winter.—Prize Essay of the Highland Society, N. S., No. xx.—See also Mr. William Hogg on Winter Pasturage, ibid No. xxii.

The state of vegetation throughout winter depends much upon that of the atmosphere about the beginning of the season. If it commences with a sharp frost, unaccompanied with snow, it nips the late spring grasses, and blights all that have not attained maturity, so that they do not again resume their freshness. If it begin with immoderate rains and sleet, it so cools and washes the surface of the land, that a state of decay immediately commences. Mr. Sinclair has observed, that "when the average daily temperature has not materially exceeded 46° of Fahrenheit, the growth of pasture is, to all practical utility, stationary; and when the herbage that is produced under a low temperature, and at a season when the influence of the sun is weakest, is chemically examined, the saccharine and mucilaginous matters, particularly the former, are scarcely one-third so much as in the herbage produced in a temperature when the sun is nearly at its highest degree." No kind of weather, however, prolongs the winter verdure more certainly than a steady frost, accompanied with snow; for in that dry state of the air, snow affords a protection to immature plants, which, under its cherishing cover, acquire somewhat more of solidity and ripeness.

GRASS-LAND

Of every kind may also be improved by merely combining the seeds with a top-dressing of compost, or by simply harrowing in the seeds at the proper season. The first method requires the smallest quantity of seeds, and they will be more productive during the first year; but by the latter a greater extent of pasture may be sown, and at a less expense.

In the *first mode*, the top-dressing, before being applied, should be reduced to a finely divided state, and should, if possible, consist of such materials as will improve the texture of the surface-soil, as well as possess the essential principle of enriching it: thus one-half spit-dung and one-half sandy or light earth, partly road-scrapings, coal and wood ashes, scourings of ditches, and dry pond-mud, previously mixed with hot lime, and frequently turned during several months, have been used with success. The hot lime is, however, only to be used in the composts of ditch and pond mud, in which it is absolutely necessary, in order to bring those substances into action. The compost being thus prepared, and in such a medium state between moisture and dryness as to crumble freely under the spade, is then in a fit condition to be mixed with the seeds; but this should be delayed until the day of sowing. They are best mixed with the top-dressing by passing both at the same time through a coarse wire sieve; and, after a little practice, two men can prepare a large quantity in one day. It ought not to be less than ten cubic yards per acre.

The sward must be prepared for the reception of the seed by an ample harrowing, or coarse scarifying, so effectually performed as to bring the dressing into complete contact with the soil; and the operation, so far from injuring the old turf, will be found to benefit it. Rolling, however, unless the land be very light, is not necessary, and, if the ground be in a damp state, may be attended with mischief. The best season is any time in March, or early in April, according as the state of the weather and the nature of the soil admit of the most effective working of the harrows or scarifying. If, however, the pasture be laid up for hay, the older grasses will greatly injure, or perhaps overpower, the seedlings; the proper course is, therefore, to pasture with young cattle stock, and to keep off sheep during the first year.

In the *second mode*, the grasses by which the turf is to be renovated are,

It must, however, be observed, that there is no allowance made for the year's rent and taxes, or for the expenses incurred by the previous summer fallow of the arable land, nor any charge for restoring that from whence the turf was taken; the real cost should, therefore, be stated at considerably more. With the view, however, of lessening this outlay, some experiments were made at Holkham, under the immediate inspection of Mr. Coke, for the purpose of ascertaining whether crops of corn or pulse could not be sown at the same time as the transplantation of the turf, without injury to the future pasture, and in this we learn that he has partly succeeded. A piece of arable land, which had borne a crop of Swedish turnips, was ploughed, harrowed, and transplanted with turf in the month of March, and four bushels per acre of Poland oats were sown broadcast at the same time with some clover; the seed being scarified in before the turf was planted, and the whole afterwards lightly rolled. The result was, that the oats produced a crop which was estimated at six quarters per acre, and were reaped without injury to the young pasture, although the bottom was full of grass; but although quite covered with plants, yet fewer of them perfected and shed their seeds than in two other experiments, in which Heligoland beans were dibbled along with the turf.

Chapter XXXIV.

IRRIGATION.

The first and simplest method of flooding land contiguous to rivers was by making a weir, or temporary dam, across the latter, and cutting an outlet into the upper part of the land to be flooded; by which the water was spread over the surface of the dry ground, and either allowed to sink or remain to be evaporated by the expedient called *warping*, or by making tail-drains to carry it off again into the river at a point below; and when so done, the process was called *irrigation*.

This expedient of the agriculturist, which arose at a very early period in tropical countries, has in temperate climates been found to be, wherever practicable, highly beneficial for expediting the growth of grass, and increasing the bulk of hay. So much was it in vogue in England at one time, that there is scarcely an acre of old meadow bounded by a river or brook to be met with in the southern counties, but has been at some former period laid out for irrigation. In those days, the greatest difficulty in the way of keeping live stock through the winter was the want of suitable fodder. Horses and horned cattle had only straw for their rack and crib provender when driven from the common pastures by frost and snow. Hay was then a scarce and valuable article, reserved for saddle-horses only, and but scantily in use among the generality of light-land farmers. On such farms, and to such farmers, meadow-land was particularly valuable: indeed, so highly was it then valued, that even to this day it is preserved and protected by penalties and special conditions in leases. Every acre of meadow added considerably to the rent of a farm; and if a tract of such land happened to lie along the side of a river, it was accounted doubly valuable: for to procure a double quantity of winter fodder was a material object; and as this could only be obtained by irrigation, the practice seems to have been imposed on the farmer as a duty due to himself.

At present, however, watering meadows is no longer a part of the ordinary business of farming in the south of England, whether situated near rivers or not. The custom fell much into disuse, as soon as it was discovered that winter fodder could be raised on arable land in sufficient quantity, and of far better quality than any produced from watered meadows. The introduction of green crops, viz., clover, rye-grass, sainfoin, vetches, turnips, &c., in a great measure superseded irrigation. The cultivation of these invaluable forage plants, not only enables the farmer to keep a greater number of live stock to enrich his land and increase his profits, but the alternation of green and white crops predisposes the land to yield every thing more abundantly.

Such are the circumstances which have caused the relinquishment of irrigation in some highly cultivated districts, except in some instances, where a fresh bite of early spring-grass is found to be necessary for couples; or where rank pasturage is required for store cattle in the autumn. For these purposes irrigation is still in repute; and is of signal value to flock-masters when turnips are over, or when winter vetches have failed; and to those also who have a large herd of cattle during or after a very dry summer.

But, notwithstanding water-meadows are less necessary in highly cultivated countries than they were in former times, it is undeniable that there are many districts, more especially in the northern parts of the kingdom, where there are extensive ranges of hill-pasture, but with comparatively small portions of meadow-land. These meadows, or *haughs*, as they are called in the north, are usually intersected by rivulets, easily manageable for the purpose of irrigation. In a hilly country the streams are often precipitous; which circumstance enables the irrigator to bring on the water at a high point, and at the same time allows of its being quickly discharged again into the natural channel. Many such natural meadows among the hills might be made trebly valuable to the proprietor by the assistance of an able irrigator; who, by the proper disposition of the surface, and proper conduction of the water, could cause both an earlier growth, and increased weight of crop. Its earliness would admit the important advantage to the northern haymaker, of its being early cut, made, and carried; and by irrigating again in August or September, a thick bite of winter herbage would be obtained

The foregoing observations contain a little history of irrigation; we have now to advert to its agency as an encourager of the growth, and as a purifier or sweetener of herbage produced by it. It is a commonly received opinion, that the elementary food of plants is contained in a state of solution in water, and that no plant can exist without a supply of it in a greater or lesser degree, in a dense or in a rarefied state. Without some degree of moisture the roots of grass become withered and perish; and too great a depth of it over them (except aquatics) is equally fatal to their existence. Stagnant water on grass land encourages the worst, and kills or discourages the best kinds. Water in motion, whatever the depth may be, is less injurious than if quite at rest; and the shallower the current, and quicker its motion over the turf, the more the latter is excited into luxuriant growth.

Many different opinions are held to account for this result—that is, the luxuriant growth of grass under a thin flow of water in motion. One supposes, that a nutritious food is deposited by the water in its course, and that the greater the quantity *in transitu* the greater the deposit. This idea rests on the presumption, that mineral or decayed vegetable substances

float on the water, and that they are intercepted by, or lodged among the leaves of the plants. This may be partly true; but when it is observable, that where there is the greatest quantity of sediment the grass grows least, and where there is no visible deposit or sediment whatever, there the growth is strongest, we must attribute the luxuriance to some other cause than the deposition of substances from the water. As early and as heavy crops are obtained by using the purest water, as by that which is full of all manner of impurities. Not but land is enriched by deposits of decomposed animal and vegetable matter, and which would be strongly evident in the growth of *future crops* of either grass or corn; yet for the temporary purpose of irrigation, perhaps the most transparent water is the most efficient.

It must be borne in mind, that heat, air, and light, are indispensable agents in the development, as well as in the maturation of plants. If they be kept in a low temperature—secluded from fresh air—or kept in darkness, they are inactive, or languish and die. Applying these facts while considering the effects of irrigation, we may safely conclude, that the energies of the plants are excited by being defended from the chilling night air, while they enjoy a higher degree of heat generated by the motion of the current; and, at the same time, are not excluded from the direct action and benefit of solar light. Nor can the thin covering of water be said to deprive the grass of the necessary portion of air; the agitated and rippling surface of the former unites with the latter fluid, so that there is an intimate combination which enhances, by mutual influence, the effects of both.

From these observations it would appear, that irrigation prompts the development of grass, by its instrumentality as a defence against cold air—by its generation of heat—and by its free admission of every ray of light. It moreover thickens the sward, by increasing the number, and inducing the simultaneous production of leaves, rather than by exciting the premature production of stems. By such effects irrigation is said to be a *sweetener of the turf*, because there is a thick and equal growth of leaves at bottom. There can, indeed, be no doubt that the deposit of warp, or mud, contained in most river water, possesses fertilizing properties proportionate to the soil and other substances from which it has been obtained, and that it must be in the same proportion valuable for the permanent improvement of land; but where the object is the growth of a quick succession of grass, such deposits injure the herbage, and sharper streams have been found better adapted to the purpose.

Thus much premised, we now proceed to describe the necessary steps to be observed, and the requisite labours to be performed, in laying out and forming a water-meadow. In the first place, its practicability must be ascertained. This depends on the character of the stream which is to yield and carry off the necessary supply of water. If the stream has a slow and sluggish motion, and the adjacent meads be nearly a dead level, the business is difficult, because high damming is requisite to get the water on, and equal difficulty is encountered to get it off, unless it be made to discharge at a great distance below the meadow. Where there is but little declination of the surface, much spade work is required in cutting the mains, leaders, and catch-drains, as well as graduating the slopes between the two latter; but when both the stream and its banks have a good and uniform fall, the affair is easy, and may be executed at no great expense.

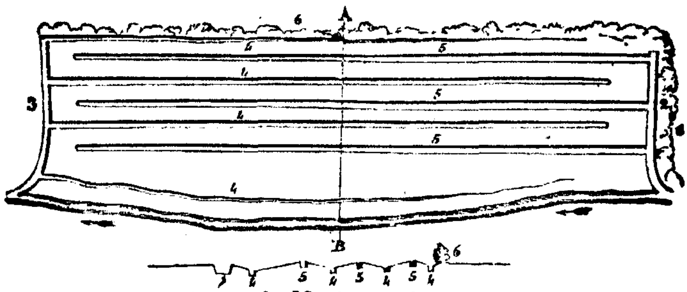
CATCH-WATER MEADOWS.

Let us suppose that there is a meadow of moderate size,—say six or eight acres,—which is intended to be irrigated. From the upper to the lower end there is a fall of five or six feet; across the upper end an open ditch is made, banked on both sides, so that it will hold water to stand one foot higher than the surface of the meadow adjoining. Into this ditch the water is admitted from the river, either by a weir or dam across, or by an open duct, cut from a point higher up the stream, which saves the expense of making a dam which may be otherwise inconvenient. A supply of, or inlet for, the water being thus secured, the next operation is laying out the leaders, inclined tables, and catch-drains. We cannot convey a clearer idea of the manner in which the surface of the water-meadow should be laid out, than by supposing that the whole was ploughed lengthways, and laid into twice-gathered lands, or ridges of eight yards wide each; along the crowns of the ridges the water-leaders are made, diminishing in width from the main at the top to where they terminate near the receiving ditch at bottom. The furrows between the lands are the catch-drains, commencing near the upper main, and terminating in the receiving ditch at bottom. These catch-drains are shallow and narrow at top, but are gradually widened and deeper as they approach the lower end. It will easily be conceived that, when the water is admitted into the leaders from the main at top, either by withdrawing little sluice-gates previously fixed, or by removing thick heavy turves used as stoppers, the water will flow along till the leaders are brimful, and running over on both sides along their whole length, it courses down the slopes, falls into the catch-drains, and is carried off into the bottom ditch, and from thence again into the river. An attendant, shod in water-tight boots, keeps an eye on the action of the leaders to see to the equal distribution of the water; and by raising or depressing the edges over which it flows, or by introducing a stopper of thick turf into the leader, regulates the flow of water in every part. If there be a full supply of water, the whole meadow may be irrigated at once; if not, one part may be done before another. It should be well understood, that the more copious the supply of water, the quicker it flows over the surface, and the sooner it is let off, the more effectual is the process, and the more rapid will be the growth of the grass.

When the surface of a meadow is undulating, the first object to be attended to is, whether the hollows can be dried by catch-drains; if so, the leaders must be made straight, or winding along the highest part of the knolls, whence it will flow down the slopes to the catch-drains in the hollows. In such cases—perhaps in all cases—a professional irrigator should be consulted, for he and his men have many resources in laying out a water-meadow which do not occur to those unacquainted with the practical part of the business.

Where there are different levels, or when the leaders, from being too long, act imperfectly, the irrigator throws his catch-work into divisions; by which the whole becomes more effectually watered, in consequence of accelerated motion being given to the water.

The annexed sketch of a catch-work water-meadow will illustrate what has been said respecting the disposition of them, and render the whole more intelligible to the reader.



Section of the Meadow at the line A B.

1 The river. 2 Main filled from the river. 3 Ditch at bottom for receiving the water from the catch-drains. 4 4 4 4 Catch-drains for carrying the water into the bottom ditch. 5 5 5 Leaders from the main, which discharge the water over the surface. 6 6 Hedges of the meadows.

Where, however, the plane of the surface of the field presents a considerable descent, the catch drains instead of being carried straight across it, are cut in an angular direction across the line of descent, with such an inclination as will best favour the gradual though certain discharge of the water; for in some situations the declivity of the ground is so great as to render it necessary to make leaders at certain distances below each other, to catch the water at different points of the fall, and thus prevent its too rapid passage.

This kind of water-meadow is seldom very expensive; the stream being usually small and manageable, few hatches or sluice-gates are necessary, and the land lying on a declivity, much less manual labour is required to throw the water over it regularly, and particularly to get it off again, than in *Flowing-Meadows:* another mode of effecting the operation that is very generally practised in South Wiltshire, where it is perhaps better understood than in any other part of the kingdom, and which we accordingly extract from the Survey of the County.

FLOW-MEADOWS.

"In the formation of these much more labour and system are required than in the former. The land applied to this purpose being frequently a flat morass, the first object to be considered is, *how the water is to be carried off* when once brought on; and in such situations, this can rarely be done without throwing the land up in high ridges, with deep drains between them. A main carriage is taken out of the stream, at a level high enough to command the top of the ridges, and the water is brought by small trenches along the tops of each ridge, and by means of moveable stops of turf or earth, is thrown over or on each side, and received by the drains below, whence it is collected into a main drain, and carried on to water other meadows, or the lower part of the same meadow. A tier of these ridges watered at one time, is called 'a pitch of work.' The size of the ridges varies according to the supply of water, but in general they are about 30 or 40 feet wide, and 9 or 10 poles long."

"It is obvious from this description, that, as the water is here used only in *one pitch*, this method is only applicable to large streams, or to valleys

subject to floods; and that, as the ridges must be formed by manual labour, and the hatches requisite to command the water on rivers must be much more expensive than those on small brooks, the first cost of the flowing-meadow is considerably greater than of the more simple method first described: amounting perhaps to from 12*l.* to 20*l.* per acre."

Before commencing any mode of irrigation, the following questions have however been pertinently proposed in a late treatise by Mr. Stephens, namely:—

"Will the stream of water to be used in irrigating the meadow admit of a dam across it?"

"Can you dam up the water high enough to run over the surface of your land without injuring that of your neighbour? or, is the water already high enough without a dam? or, can you make it so by diverting it out of the stream higher up, and, by a conductor, carry it nearly level till it enter the meadow?" And,

"Can you draw it off your meadow as fast as it is brought on, without being stagnated on the surface?"

This latter point should, indeed, be very particularly attended to in the formation of every irrigated meadow, for it is a remarkable fact that swampy land, which bears little else than rushes, flags, and the coarsest grasses, if laid into form and irrigated, becomes as fine pasturage as any other drier and firmer soil, provided no water be allowed to remain stagnant upon it. It should, however, be understood, that the entire surface should be rendered so smooth, that there should not be a hollow, nor a hillock, left, in which a drop of water can stand, or over which it cannot flow. A small sluice should also be cut by the side of the conductor in every irrigated meadow, for the purpose of letting out any waste water that may make its escape through the head sluices; for it is equally important to keep the meadow generally dry, as to lay it wet at particular seasons, and, if this be neglected, land, otherwise not of a wet nature, will in a very short time become boggy, or covered with rushes. It should, indeed, be well drained; for if it be converted into water-meadow without attending to that object, however accurately the surface may be formed, the crops will be inferior to what they might have otherwise been. In case of a wet summer, the meadows will not require watering after the second time, and indeed the drier they can be kept the better; but if the season be dry, the water should be thrown over them whenever they may seem to want it, and the cattle taken out until the ground is again firm. Two days' watering, and, in very hot weather, even a few hours will be sufficient: always remembering not to allow the water to leave a scum upon the land.

WATER-MEADOWS.

The *advantages arising from water-meadows* are too well known to require elucidation: there is indeed no crop that a farmer can cultivate which is so much at his command, as that grown upon such land, and every one who keeps a flock of breeding sheep upon the cold down-lands of Wilts, Hants, and Dorset, is well aware that in the pinching season of spring, he who has not that resource in store, is generally put to the greatest shifts for their support; the ewes shrinking their milk, and the lambs becoming stunted to a degree from which the best summer feed will not afterwards recover them. The soil in many parts of that district is not favourable to the production of turnips, and, in exposed situations, even rye-grass seldom affords a bite for sheep until May-

day. It therefore follows, that a farmer under such circumstances has no other certain expedient for the maintenance of his flock during that period but hay; and even in that he is sometimes disappointed, by having been compelled, by the scarcity of the preceding spring, to feed the land which he would otherwise have laid up for provender; he is, therefore, under the necessity of purchasing fodder, perhaps at the distance of many miles. From this ruinous call upon his pocket, he who has got a fair portion of water-meadow is however exempt: he shuts them up so early as to be certain of a crop, and his lambs are as forward at May-day as those of his less-fortunate neighbours are at Midsummer. The abstract value of the produce of a water-meadow has been not unfairly stated at about 10*l.* per acre*; but its value, when considered as part of a sheep-breeding farm, is almost beyond computation, and once it is completely made, it may be said to last for ever: the whole annual expense of keeping up the works and watering it, not amounting to anything like the charge for manure on other grass-land †.

* An account of the average expenses and produce of medium water-meadow is thus stated in Vancouver's Report of Hampshire, on the authority of gentlemen of candour and respectability in the county:—

	£.	s.	d.		£.	s.	d.
To interest of money expended in its formation	0	5	0	By agistment of 400 couples for one day, at 7*d.* per couple weekly	1	13	4
Keeping sluices, &c. in repair	0	7	6	30 cwt. of hay, at 3*s.* 3*d.* per cwt.	4	17	6
Scouring, levelling, and righting the surface, preparatory to the winter-watering, and after the spring-feeding	0	6	0	Value of second crop and after-grass until shut up for watering in November	2	12	6
Mowing, making, and thatching the hay	1	0	0				
Rent	2	10	0				
Tithes, on rack-rent	0	12	6				
Parochial assessments	0	15	0				
Hurdles for penning off, and expenses of removal	0	2	6				
Total expense	5	18	6				
Net profit	3	4	10				
	£9	3	4		£9	3	4

The profit thus appears to be 3*l.* 4*s.* 10*d.* per acre yearly, exclusive of the value of folding; which, calculating the 400 couples at only 600 grown sheep, and estimating the teathe of 3600 as equal in value to a dressing of farm-yard dung which costs 5*l.*, is worth 16*s.* 8*d.*—p. 276.

† In Smith's "Observations on Water-Meadows" there is the following account of an irrigated meadow of nine acres of the Prisley bog, near Woburn, belonging to his Grace the Duke of Bedford, the drainage of which by Elkington, though rewarded by a parliamentary grant, failed, until it was some years afterwards completed under Mr. Smith's inspection.

In the month of March the meadow was stocked with 240 sheep for three weeks, at 6*d.* each per week, thus making the spring feed amount to 40*s.* per acre. In June, two tons of hay per acre were mown; and on the 20th of August, one ton and a half more per acre. The 16th of September 80 sheep were put on for three weeks; after which the land was fed by lean bullocks, which are not reckoned in the account, yet the produce is stated to have amounted to 16*l.* 13*s.* 4*d.* per acre. In the following year it was stocked so earl as February with 164 hog-sheep for nine weeks, their estimated keep being worth 5*d.* each: the spring feed thus amounting to 3*l.* 8*s.* 4*d.* per acre; and on the 26th of April it was shut up for hay.—p. 109.

A catch-work meadow of eight acres of gravelly sub-soil, prepared in 1829 and 1830, in separate divisions, at an expense of from 4*l.* to 9*l.* per acre, is said by Mr. Stephens, in his Practical Irrigator," to have produced, in 1833, three hundred stone of hay per

The general *management of water-meadows* throughout the greater part of that country is, to eat the after-grass off quite bare in the autumn, when the manager of the mead,—provincially termed "the drowner,"—begins to clean out the main drain and the main carriage, and "to right up the works": that is, to make good all the carriages and drains which the cattle have trodden in, so as to have one tier or pitch of work ready for drawing. This is immediately put under water whilst the next pitch is preparing; and this work ought to be done, if possible, early enough to have the whole meadow ready to catch the first floods after Michaelmas. The length of time which the water should be allowed to remain cannot be correctly stated, as much depends upon local circumstances; but if it can be commanded in abundance, the usual custom is to give the land a thorough soaking at first, perhaps for a fortnight or three weeks, with an intermission of two or three days during that period, or sometimes for the space of two fortnights, with an interval of a week between each.

This first soaking is to encourage the shooting of new roots which are continually forming, as well as to support the forced growth; but while the grass grows freely a fresh watering is not wanted; though when it flags it should be repeated for a few days at a time, always keeping this fundamental rule in mind—"To make the meadow as dry as possible after every watering; and to take off the water the moment any scum appears upon the land, as this shows that it has already had water enough." Some meadows that will thus require the water for three weeks in October, and the two following months, will not perhaps bear it a week in February or March, and sometimes scarcely two days in April and May.

Stock, but chiefly sheep, are commonly turned upon those meadows in the middle of March, care being taken to keep them as dry as possible fo some days before the sheep begin to feed there; and as it is not usual to allow them to enter while the dew is on, the general hours are from ten or eleven in the morning to four or five in the evening, when they are driven to the fold. The pasturage is considered perfectly safe for sheep in the spring, but will rot them in the autumn. One acre of good grass is thought to be sufficient to feed five hundred couples a-day. When not afterwards used for the production of hay, dairy-cows or young cattle are usually turned in*.

The making of *water-meadow hay* differs only from the general practice, in requiring rather more care in repeatedly turning and tedding, so as to make it as quickly as possible, and seeing that the trenches and drains are raked clean out. There is some difficulty in carrying the crop from ground cut up by such numbers of drains and feeders, which renders the employment of carts inconvenient; but hay-sweeps can be used with facility, and steady horses soon learn to step across the drains without injuring

acre, (probably Scotch acres, though not so stated,) worth, in general, 6*d*. per stone on the part first irrigated, and two hundred on the second, with every probability of the second producing an equal quantity within two years from that time. The after-grass was generally worth 20*s*. per acre.—P. 80. See also the Gen. Rep. of Scotland, vol. ii. p. 601.

* On the demesne of Dunster Castle, in Somersetshire, a large tract of land, in a convertible course of tillage, is manured with water. The usual rotation of crops is,—1st, wheat on the ley; 2d, turnips; 3d, barley and artificial grasses. It is then suffered to remain in pasture two years, and during that time, it is, at stated intervals, regularly flooded by a stream descending from the adjacent hills. The course is then renewed, and this has been the constant practice for many years. The produce has been in general very considerable; and has, indeed, been stated so high as 40 to 50 bushels of wheat, and of barley 50 to 60 bushels per acre.

them. The grass being frequently large and coarse, it is proper to cut it young; and if it be well made, it is of a peculiarly nourishing milky quality, either for ewes or dairy-cows. It is rarely given to horses, as it is not thought to possess substance enough for their support, though it has been asserted that some teams were never in better condition than when fed upon it*: if over-watered, particularly in summer, it may, however, be attended with some risk if given to stock of any kind. In some instances the meadows are laid up for a second crop, but the grass is of such a soft nature, and takes so much time to dry, that the hay is seldom well saved; the rowen is therefore generally fed off by dairy-cows, which remain upon the land until the manager begins to prepare for winter watering.

Objections are sometimes made to water-meadow-hay, on the ground that, in those parts of the country where grass-land is abundant, its chief advantages—which consist in the earliness and largeness of the crop—are rendered of less value by the better quality of hay produced upon uplands. The coarseness of water-mead-hay is not, however, so generally the fault of the herbage as that of the farmer, who, not uncommonly, allows the grass to become over-ripe, with a view to the increase of its quantity; but, if cut while young, although the hay may not contain so much nutriment as that made upon dry meadows, yet cows are more fond of it, and it will produce more milk. Perhaps, however, in many counties, and particularly on dairy-farms, it would answer a better end if water-meadows were to be always fed and never mown.

On the *feeding of water-meadows* it has been justly remarked in the Wiltshire Report, that "the advantage of the first flush of grass a month before the upland meadows will produce it must be obvious to every one: when this is eaten up, the land intended for summer feeding will be ready to take stock; the water may then be thrown over the water-meadows for a fortnight, and a new supply of grass produced that will again take the cows, by the time they have eaten off the first shoot of the summer pastures. By this means the meadows may be fed during the entire summer, and the quantity of grass they will produce—especially in a dry season—as well as the milkiness of its nature, is inconceivable to those who have not tried it." These advantages are indeed not only apparent to dairy farmers, but must also be strikingly evident to those who raise large quantities of veal for the early supply of London and other great cities; whose business must be materially assisted by an increased flow of milk a month sooner than it can be obtained from pasture on dry meadows.

With regard to soil, the advantage is, if possible, to have it on a warm, absorbent bottom; for the subsoil of water-meadow is considered to be of more consequence than the quality or depth of the top-soil. A loose gravel, or what is still better, a bed of broken flint, with a little intermixture of earth, is perhaps the most desirable bottom, and in many of the best meadows where it is of this nature, the surface soil is not six inches in depth; but a gravelly or sandy soil with a mixture of loam, or any soil partaking generally of those qualities, with a sufficient head for the water, and a proper descent to carry it off, is applicable to the purpose †.

* Transactions of the Highland Soc., vol. iii. p. 283.

† See Davis's Survey of Wiltshire, parts 1 and 2, chap. xii. sect. 4. Boswell and Smith, on Water-Meadows; and Stephens on Practical Draining and Irrigation. Billingley's Survey of Somersetshire, p. 266. Also Sinclair's Code of Agriculture, 3rd edit. p. 296.

SUMMARY.

Taking into consideration all these circumstances, there can be no doubt that the improvement of land by irrigation is of the very first importance, and should never be neglected wherever practicable: that is to say—wherever the elevation of the land will allow of the water being flowed over it, and afterwards drained off; for, in such situations, any kind of ground, be it ever so poor, may be benefited to a degree that will more than repay the charge. Most small rivulets on the sides of slopes may be dammed sufficiently for the purpose at very slight cost; and, where no impediments are occasioned either by the intervention of the holders of neighbouring property, or by mills upon the stream, the operation will not alone add to the immediate value of the estate through the profit derived from that portion of the farm so improved, but also from the facilities which it affords to the other branches of husbandry: among which, perhaps not the least is the saving which it thus occasions of all manure upon the irrigated land; for, not only is the ground maintained in its fertility solely by the application of the water, but the sheep which are fed upon it are invariably folded upon the arable.

The following is a summary of the chief points which should be attended to :—

1st.—The uncontrolled command of a constant living stream.

2d.—The indispensable necessity of effectually draining the land of all redundant water both previous to, and after, its irrigation: thus forming a dry, sound, and warm bottom.

3d.—The spring floating to be continued, if the water be not foul, till the grass has gained a considerable height; but to be only left long enough to cool the ground and keep the grass growing, and to be drawn off whenever it shows any appearance of scum upon its surface.

4th.—Care should be taken both in feeding, and in taking off hay, that it be done with a view to clear that part of the ground the earliest, on which the water can be first applied to the production of another crop: no time should therefore be lost in laying it on, the moment any portion of the land can be cleared, so that the part first cut may be watered while the remaining divisions are getting ready.

5th.—Sheep should not be turned into water-meadow grass too early in the morning; but should be kept upon the fallows, or upon some dry ground, until the dew be off.

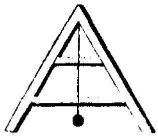
With regard to the best seasons for flooding land, and the length of time the water should be allowed to remain, they depend so much on local circumstance and season, that their discussion would lead us too far; and on those points we can only refer to what we have already stated.

The *first expense of irrigation* being very considerable—though varying, according to the difficulty of the ground and the nature of the work to be performed *—many prudent farmers will necessarily calculate, in the first instance, the obstacles which they may be likely to meet with in the progress of the work, whether arising from the nature of

* Various accounts have been stated in the County Surveys, and in the Communications to the Board of Agriculture, as well as by the authors whom we have already quoted, regarding the charges of the operation, which are so uncertain as to amount, under different circumstances, from 5*l.* to 20*l.* and even 30*l.*, and in one instance to no less than 40*l.* per acre.

the ground or the state of the stream, and his right to use it without interfering with the property of others. Having obviated those inconveniences—if he conceive himself capable of laying out the drains without the assistance of a professional man—he should take a level from the highest spot where the stream enters his property, following it to the dead level, and at every three or four hundred yards staking it out slowly, one stake on the dead level, and another near it, descending so many inches at an allowance to give the water a current. Two inches in a mile will move the water; though from twelve to twenty should be allowed in order to ensure a proper descent.

The instrument called a spirit or water level is the most proper for ascertaining the inclination of the ground with certainty, but it is both more complex and expensive than may suit the generality of farmers, and one more simple and almost equally effective may be made by any man in the form designed underneath. In America, where it is much used for ascertaining the declination of land, it is called a *rafter-level;* but it is also well known, though on a smaller scale, to all carpenters and masons. When employed for that purpose it should be made—for the convenience of carriage—ten or twelve feet in the span, of light spars not more than a couple of inches in breadth, though strongly put together. The plummet is hung to a line, so as to act as a pendulum, and the lower bar is marked off in inches from the centre. One foot of the level is then held on the surface of the water, or on the place from whence it is to be taken, and the other foot is put on the spot pointed out by the plummet standing exactly in the middle. By then moving the instrument forwards, either the rise or fall of the land will be pointed out by the undulation of the plummet; and thus, by marking the line of its descent with small sticks, or pegs, fixed in the ground at short distances, the course through which the water should be conducted can be laid down with tolerable accuracy.



END OF VOLUME THE FIRST.

ERRATA.

In the Memoranda, at the end of the Introduction, at l. 50, read 54; and at the close of that paragraph, add "lime per chaldron of 36 bushels."

At p. 74, the references † ‡ § should stand thus * † ‡.
" 148, l. 43, for "23*s*." read "20*s*."
" 150, l. 40, for "perches," read "pecks."
" 153, l. 9, after the word "inches," add "in."
" 176, note, for "Clive," read "Cline."
" 356, l. 22, for "wild," read "mild."
" 376, l. 31, omit the words "slaking by."
" 392, after the title to Chap. XIX. omit the word "continued."
" 431, the reference to the note commencing with "The discoveries," should be placed at p. 432, l. 26.

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